Climate Change Impact Assessment on Crop Production in Uzbekistan

World Bank Study on Reducing Vulnerability to Climate Change in Europe and Central Asia (ECA) Agricultural Systems

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1 Introduction

The World Bank has embarked on a study on climate change impact assessment and adaptation strategy identification and evaluation for each of four countries in the Eastern Europe/Central Asia (ECA) region. The overall objective is to enhance the ability of these four countries to mainstream climate change adaptation into agricultural policies, programs, and investments. This objective will be achieved by raising awareness of the threat, analyzing potential impacts and adaptation responses, and building capacity among national and local stakeholders with respect to assessing the impacts of climate change and developing adaptation measures in the agricultural sector.

The four countries selected to be included in the study are Albania, Macedonia, Moldova and Uzbekistan. The study is undertaken by Industrial Economics (Cambridge, MA, USA) with as subcontractor FutureWater (Wageningen, The Netherlands).

A major component of the study is the analytical assessment of the impact of climate change on crop production in the four countries and the evaluation of a set of adaptation measures. Results of these analysis will be used to support capacity building, awareness rising and linkage with the water resources analysis.

This report describes the impact assessment for Uzbekistan using the state-of-the-art AquaCrop model.

2 Methods and Data

2.1 Overview

Several crops were recommended by the Uzbek counterparts as the most important to evaluate within the study. To study the climate impact on these rainfed and/or irrigated crops, the following two approaches were used, to assess:

a) The impact on yields, assuming same future irrigation amounts
b) The impact on crop irrigation water requirements, assuming same future yields

These two approaches guarantee an integral overview of the possible consequences on the agricultural production and water demands under different climate scenarios for each agro-ecological zone and for each crop in Uzbekistan.

To assess (a) and (b), simulations have been carried out over a large number of dimensions, as is summarized in Table 1. The results of these simulations are evaluated over decadal periods from 2010 until 2050. These results were compared with the reference situation which was taken as 2000-2010.

Table 1. Dimensions for modeling assessment

Type	**A** **Crop types**	**B** **Agro-Ecological Zones**	**C** **Climate scenarios**	**D** **CO2 fertilization**
Classes	1. Alfalfa 2. Apples 3. Cotton 4. Grassland 5. Potatoes 6. Tomatoes 7. Winter Wheat 8. Spring Wheat	1. Desert & Steppe, RB 2 2. Desert &Steppe, RB 5 3. Highlands, RB 3 4. Piedmont zone, RB 1 5. Piedmont zone, RB 3	1. Baseline 2. Low 3. Median 4. High	1. Yes 2. No
Number	**8**	**5**	**4**	**2**
	Total dimensions (A*B*C*D) **= 400**			

2.2 Model selection

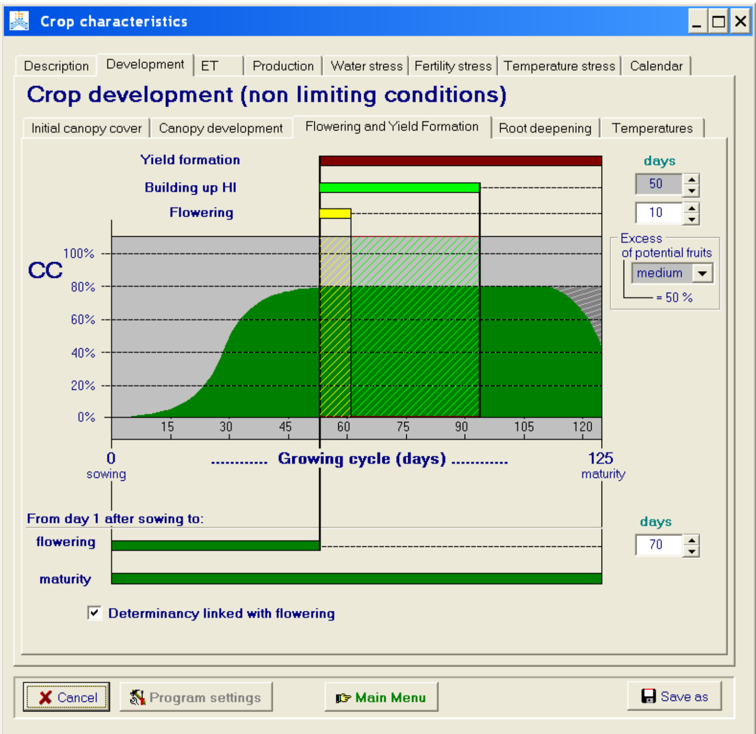
Potential impacts of climate change on world food supply have been estimated in several studies (Parry et al., 2004). Results show that some regions may improve production, while others suffer yield losses. This could lead to shifts of agricultural production zones around the world. Furthermore, different crops will be affected differently, leading to the need for adaptation of supporting industries and markets. Climate change may alter the competitive position of countries with respect, for example, to exports of agricultural products. This may result from yields increasing as a result of altered climate in one country, whilst being reduced in another. The altered competitive position may not only affect exports, but also regional and farm-level income, and rural employment.

In order to evaluate the effect of climate change on crop production and to assess the impact of potential adaptation strategies models are used frequently (Aerts and Droogers, 2004). The use of these models can be summarized as: (i) better understanding of water-food-climate change interactions, and (ii) exploring options to improve agricultural production now and under future climates. Some of the frequently applied agricultural models are:

- CropWat
- AquaCrop
- CropSyst
- SWAP/WOFOST
- CERES
- DSSAT
- EPIC

Each of these models is able to simulate crop growth for a range of crops. The main differences between these models are the representation of physical processes and the main focus of the model. Some of the models mentioned are strong in analysing the impact of fertilizer use, the ability to simulate different crop varieties, farmer practices, etc. However, for the project it is required to use models with a strong emphasis on crop-water-climate interactions. The three models that are specifically strong on the relationship between water availability, crop growth and climate change are CropWat, AquaCrop and SWAP/WOFOST. Moreover, these three models are in the public domain, have been applied world-wide frequently, and have a user-friendly interface (Figure 1). Based on previous experiences it was selected to use AquaCrop as it has:

- limited data requirements,
- a user-friendly interface enabling non-specialist to develop scenarios,
- focus on climate change, CO_2, water and crop yields,
- developed and supported by FAO,
- fast growing group of users world-wide,
- flexibility in expanding level of detail.



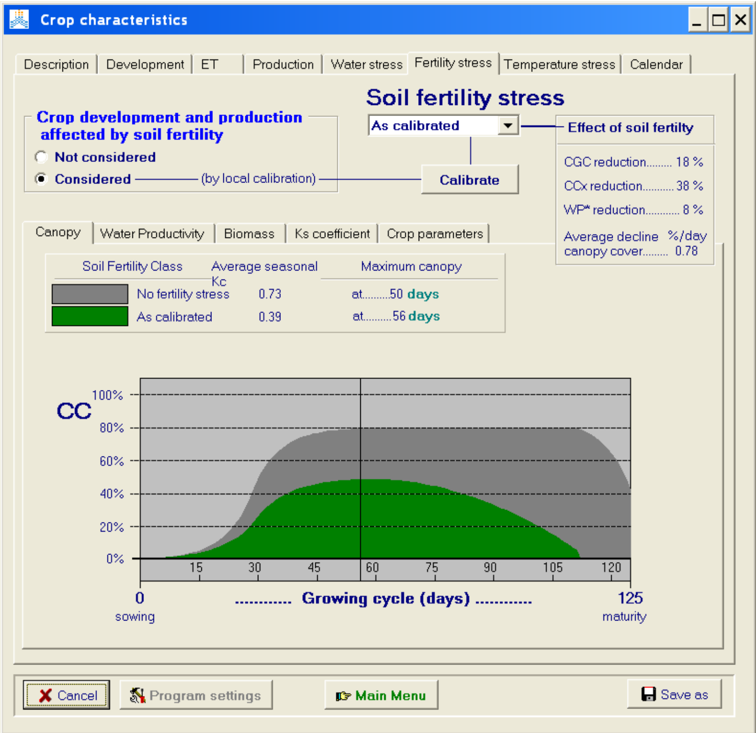


Figure 1. Typical examples of input screen of AquaCrop: crop development (top) and soil fertility stress (bottom).

2.3 Model specifications

AquaCrop is the FAO crop-model to simulate yield response to water. It is designed to balance simplicity, accuracy and robustness, and is particularly suited to address conditions where water is a key limiting factor in crop production. AquaCrop is a companion tool for a wide range of users and applications including yield prediction under climate change scenarios. AquaCrop is a completely revised version of the successful CropWat model. The main difference between CropWat and AquaCrop is that the latter includes more advanced crop growth routines.

AquaCrop includes the following sub-model components: the soil, with its water balance; the crop, with its development, growth and yield; the atmosphere, with its thermal regime, rainfall, evaporative demand and CO2 concentration; and the management, with its major agronomic practice such as irrigation and fertilization. AquaCrop flowchart is shown in Figure 2.

The particular features that distinguishes AquaCrop from other crop models is its focus on water, the use of ground canopy cover instead of leaf area index, and the use of water productivity values normalized for atmospheric evaporative demand and of carbon dioxide concentration. This enables the model with the extrapolation capacity to diverse locations and seasons, including future climate scenarios. Moreover, although the model is simple, it gives particular attention to the fundamental processes involved in crop productivity and in the responses to water, from a physiological and agronomic background perspective.

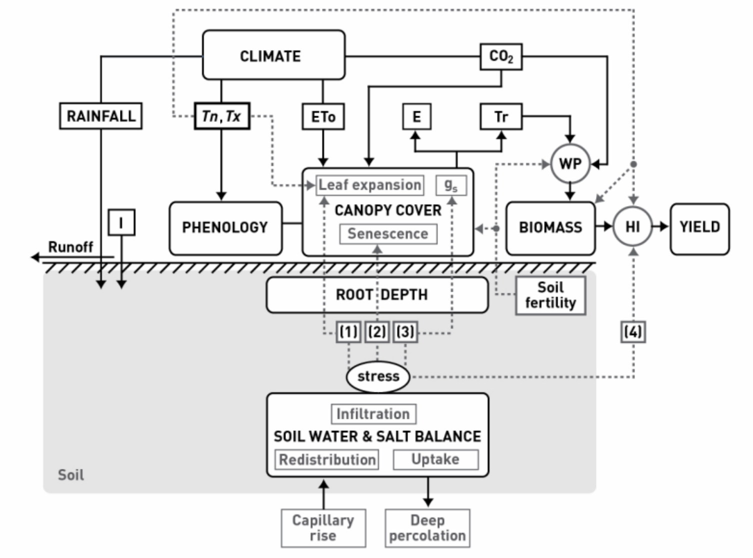


Figure 2. Main processes included in AquaCrop.

2.3.1 Theoretical assumptions

The complexity of crop responses to water deficits led to the use of empirical production functions as the most practical option to assess crop yield response to water. Among the empirical function approaches, FAO Irrigation & Drainage Paper nr 33 (Doorenbos and Kassam, 1979) represented an important source to determine the yield response to water of field, vegetable and tree crops, through the following equation:

$$\left(\frac{Y_x - Y_a}{Y_x}\right) = k_y\left(\frac{ET_x - ET_a}{ET_x}\right) \qquad \text{Eq. 1}$$

where Y_x and Ya are the maximum and actual yield, ET_x and ETa are the maximum and actual evapotranspiration, and k_y is the proportionality factor between relative yield loss and relative reduction in evapotranspiration.

AquaCrop evolves from the previous Doorenbos and Kassam (1979) approach by separating (i) the ET into soil evaporation (E) and crop transpiration (Tr) and (ii) the final yield (Y) into biomass (B) and harvest index (HI). The separation of ET into E and Tr avoids the confounding effect of the non-productive consumptive use of water (E). This is important especially during incomplete ground cover. The separation of Y into B and HI allows the distinction of the basic functional relations between environment and B from those between environment and HI. These relations are in fact fundamentally different and their use avoids the confounding effects of water stress on B and on HI. The changes described led to the following equation at the core of the AquaCrop growth engine:

$$B = WP \cdot \Sigma Tr \qquad \text{Eq. 2}$$

where Tr is the crop transpiration (in mm) and WP is the water productivity parameter (kg of biomass per m^2 and per mm of cumulated water transpired over the time period in which the biomass is produced). This step from Eq. 1.1 to Eq. 1.2 has a fundamental implication for the robustness of the model due to the conservative behavior of WP (Steduto et al., 2007). It is worth noticing, though, that both equations are different expressions of a *water-driven growth-*

engine in terms of crop modeling design (Steduto, 2003). The other main change from Eq. 1.1 to AquaCrop is in the time scale used for each one. In the case of Eq. 1.1, the relationship is used seasonally or for long periods (of the order of months), while in the case of Eq. 1.2 the relationship is used for daily time steps, a period that is closer to the time scale of crop responses to water deficits.

The main components included in AquaCrop to calculate crop growth are Figure 3:

- Atmosphere
- Crop
- Soil
- Field management
- Irrigation management

These five components will be discussed here shortly in the following sections. More details can be found in the AquaCrop documentation (Raes et al., 2009)

Figure 3. Overview of AuqaCrop showing the most relevant components.

2.3.2 Atmosphere

The minimum weather data requirements of AquaCrop include the following five parameters:

- daily minimum air temperatures
- daily maximum air temperatures
- daily rainfall
- daily evaporative demand of the atmosphere expressed as reference evapotranspiration (ET_o)
- mean annual carbon dioxide concentration in the bulk atmosphere

The reference evapotranspiration (ET_o) is, in contrast to CropWat, not calculated by AquaCrop itself, but is a required input parameter. This enables the user to apply whatever ETo method based on common practice in a certain region and/or availability of data. From the various options to calculate ETo reference is made to the Penman-Monteith method as described by FAO (Allen *et al.*, 1998). The same publication makes also reference to the Hargreaves method in case of data shortage.

A companion software program (ETo calculator) based on the FAO56 publication might be used if preference is given to the Penman-Monteith method. A few additional parameters were used for a more reliable estimate of the reference evapotranspiration. Besides the minimum and maximum temperature, measured dewpoint temperature and windspeed were used for the calculation.

AquaCrop calculations are performed always at a daily time-step. However, input is not required at a daily time-step, but can also be provided at 10-daily or monthly intervals. The model itself interpolates these data to daily time steps. The only exception is the CO_2 levels which should be provided at annual time-step and are considered to be constant during the year.

2.3.3 Crop

AquaCrop considers five major components and associated dynamic responses which are used to simulate crop growth and yield development:

- phenology
- aerial canopy
- rooting depth
- biomass production
- harvestable yield

As mentioned earlier, AquaCrop strengths are on the crop responses to water stress. If water is limiting this will have an impact on the following three crop growth processes:

- reduction of the canopy expansion rate (typically during initial growth)
- acceleration of senescence (typically during completed and late growth)
- closure of stomata (typically during completed growth)

Finally, the model has two options for crop growth and development processes:

- calendar based: the user has to specify planting/sowing data
- thermal based on Growing Degree Days (GDD): the model determines when planting-sowing starts.

2.3.4 Soil

AquaCrop is flexible in terms of description of the soil system. Special features:

- Up to five horizons
- Hydraulic characteristics:
    - hydraulic conductivity at saturation
    - volumetric water content at saturation
    - field capacity
    - wilting point
- Soil fertility can be defined as additional stress on crop growth influenced by:
    - water productivity parameter
    - the canopy growth development
    - maximum canopy cover

- rate of decline in green canopy during senescence.

AquaCrop separates soil evaporation (E) from crop transpiration (Tr). The simulation of Tr is based on:

- Reference evapotranspiration
- Soil moisture content
- Rooting depth

Simulation of soil evaporation depends on:

- Reference evapotranspiration
- Soil moisture content
- Mulching
- Canopy cover
- Partial wetting by localized irrigation
- Shading of the ground by the canopy

2.3.5 *Field management*

Characteristics of general field management can be specified and are reflecting two groups of field management aspects: soil fertility levels and practices that affect the soil water balance. In terms of fertility levels one can select from pre-defined levels (non limiting, near optimal, moderate and poor) or specify parameters obtained from calibration. Field management options influencing the soil water balance that can be specified in AquaCrop are mulching, runoff reduction and soil bunds.

2.3.6 *Irrigation management*

Simulation of irrigation management is one of the strengths of AquaCrop with the following options:

- rainfed-agriculture (no irrigation)
- sprinkler irrigation
- drip irrigation
- surface irrigation by basin
- surface irrigation by border
- surface irrigation by furrow

Scheduling of irrigation can be simulated as

- Fixed timing
- Depletion of soil water

Irrigation application amount can be defined as:

- Fixed depth
- Back to field capacity

2.3.7 *Climate change*

The impact of climate change can be included in AquaCrop by three factors: (i) adjusting the precipitation data file, (ii) adjusting the temperature data file, (iii) impact of enhanced CO_2 levels.

The first two options are quite straightforward and require the standard procedure of creating climate input files in AquaCrop. Impact of enhanced CO_2 levels are calculated by AquaCrop itself. AquaCrop uses for this the so-called normalized water productivity (WP*) for the simulation of aboveground biomass. The WP is normalized for the atmospheric CO_2 concentration and for the climate, taking into consideration the type of crop (e.g. C3 or C4). The C4 crops assimilate carbon at twice the rate of C3 crops.

2.4 Crop parameterization

The standard AquaCrop package has some pre-defined crop files that can be used and adjusted to local conditions. Not all crops required for this particular study are included in the AquaCrop package and have been developed using expert knowledge, documentation and local expertise obtained during the capacity building workshop in Tashkent, December 2010. The following sections describe the data used to parameterize and adjust the crop files for each of the assessed crops of this study.

2.4.1 Alfalfa

Alfalfa is an important fodder crop in Uzbekistan and is always irrigated. Irrigation applications are high and on average between 700 and 800 mm, as reported by local experts. The irrigation season is from end March up to end of September.

Alfalfa is not included as one of the standard crop files within AquaCrop. Therefore, a new crop file has been created representing average conditions in Uzbekistan. The latest version of AquaCrop (3.1) does not support yet the so-called forage crop type. However, using the leafy vegetable producing crops, one can mimic alfalfa, with the exception of multiple harvesting. It was therefore assumed that the total yearly yield of alfalfa is harvested at the end of the season (start of November).

Yields

Biomass production and yields are calculated by AquaCrop, like almost all other crop growth models, as dry matter. In farm management practice and crop statistics however, yields are always expressed as fresh yields. On average alfalfa has a low dry matter content of 20%, so about 80% moisture is included in the fresh yield. In order to convert AquaCrops results into fresh yields, one has to divide by 0.20. E.g.

- 1000 kg dry matter
- 1000 / 0.20 = 5,000 kg fresh
- 5,000 * 80% = 4.000 kg moisture

Alfalfa yields are not included in the FAOstat database. Only imports and exports are provided. Based on local expertise and literature it was concluded that average irrigated alfalfa yields in Uzbekistan are between 35 and 40 ton / ha (fresh yield), obtained from about 4 cuts, of around 10 ton/ha. Converting these values into dry matter yield: 40,000 kg fresh * 0.2 = 8,000 kg dry matter yield.

Crop parameters

The AquaCrop data file for alfalfa has been created by adjusting parameters to the local conditions in the country. The most important assumptions and crop information to parameterize the crop files in AquaCrop relevant to alfalfa are:

- 100% of alfalfa is irrigated in Uzbekistan.
- A total application of about 700-800 mm per year is normal practice.
- Planting density is about 75,000 plants per ha and the size of the canopy cover per plant at 90% emergence is 6.5 cm^2
- Growing season is from 1st of March to 5th of November.
- Fertility stress level (also salinization) is 50% for the entire country.
- CCx: Maximum canopy cover in fraction soil cover: it was assumed that 65% of canopy covers the soil during mid-season.
- HIo: Reference Harvest Index: set to 40% (for non-irrigated crops at 50%).

2.4.2 Apples

Apples are the most common perennial crop in Uzbekistan and rank highly in terms of total value of production. Harvested area has increased during the last two decades considerably. No standard crop file of apples is included within AquaCrop. Therefore, a new crop file has been created based on representative conditions in Uzbekistan.

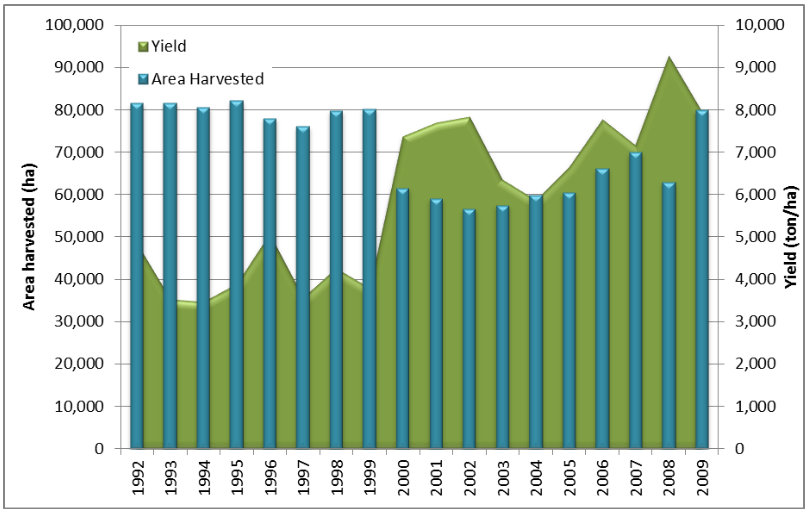


Figure 4. Apples fresh yield and harvested area during the last 18 years in Uzbekistan (source: FAOSTAT)

Crop parameters

The AquaCrop data file for apples has been created by adjusting parameters to the local conditions in the country. The most important assumptions and crop information to parameterize the crop files in AquaCrop relevant to apples are:

- Planting date: 1-Apr
- Harvest date: 28-Sep
- Irrigation: 100%
- Irrigation method: furrow
- Dry matter content harvested product: 20%
- Yields: 6 - 8 ton/ha (Fresh yield) = 1200 - 1600 kg /ha (dry matter)
- Irrigation application: 100 – 300 mm
- Moderate fertility stress level (40%)

2.4.3 Cotton

Cotton is the foremost crop grown in Uzbekistan in terms of area harvested and value of product. Uzbekistan is one of the major exporters of cotton in the world. Cotton yields have been reported to vary substantially over the last years. On average yields are reported by local farmers to be in the order between 2.2 and 3.0 ton/ha (fresh yield). All cotton is irrigated and irrigation water amounts differ as a function of rainfall and temperatures. On average 3 to 5 applications are provided. A total of 400 up to 1000 mm of irrigation is provided.

Cotton is planted in Uzbekistan at the end of April and the harvest takes place in the end of September up to mid October. Fertilizer application has been reduced during the last years following recommendations, but is still relatively high. Land quality is however limited in most regions and fertility stress is still considerable due to the relatively poor and salt-stressed soils.

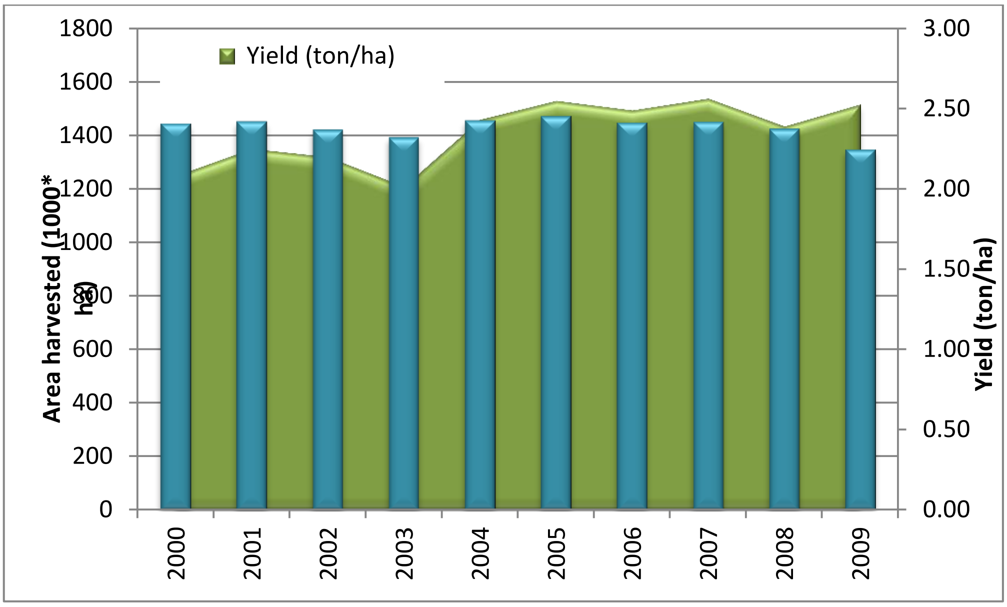


Figure 5. Cotton fresh yield and harvested area during the last 10 years in Uzbekistan (source: local statistics)

Crop parameters

The AquaCrop data file for cotton has been created by adjusting non-conservative parameters of the existing crop file to the local conditions in the country. The most important assumptions and crop information used to parameterize the crop files in AquaCrop are:

- Planting date: End of April
- Harvest date: Start October
- Dry matter content harvested product: 90%
- Irrigation: 100%
- Irrigation method: furrow
- Irrigation application: 400 – 1000 mm
- Fertilizer status: sub-optimal, stress level 50%
- Harvest index: 25%

2.4.4 Grasslands

Grasslands are grown under quite diverse conditions and management practices in Uzbekistan. For this study a generic grassland type was considered with average crop and soil conditions. It was assumed that the growing season for grasslands were from 1-March to 1-November. Fertilizer application is generally limited and grassland is normally not irrigated.

No reliable reported grassland yield numbers are available, but it was assumed that by various cuttings and livestock grazing a total of amount of fresh product of about 5 ton/ha can be produced.

Biomass production and yields are calculated by AquaCrop as dry matter. In farm management practice and crop statistics however, yields are always expressed as fresh yields. On average grasslands have a low dry matter content of only 20%, so about 80% moisture is included in the fresh yield. In order to convert AquaCrops results into fresh yields, one has to divide by 0.20. Converting a fresh yield of 5 ton/ha into dry matter gives 1,000 kg dry matter yield per hectare. A moderate fertility stress level (40%) was assumed.

2.4.5 Potatoes

Potatoes are grown under a wide range of conditions which is reflected in reported yields ranging from 20 up to 35 ton/ha (fresh yield). All potatoes are irrigated and average irrigation application is 450 mm per season, but might vary by region. Fertilizer conditions are, like all other crops in Uzbekistan, non-optimal.

Generic information from FAO (http://www.fao.org/nr/water/cropinfo_potato.html) indicates that good yields under irrigation of a crop of about 120 days in the temperate and subtropical climates are 25 to 35 ton/ha fresh tubers and in tropical climates yields are 15 to 25 ton/ha.

According to FaoStat potato yields are 24.5 ton/ha (fresh yield). This is lower than top producing countries like USA, Netherlands, and Switzerland, that produce over 45 ton/ha. Some figures for neighboring countries are: Kazakhstan 16 ton/ha, Tajikistan 24 ton/ha, Turkmenistan 6 ton/ha. Interesting is that the area under potatoes remains more or less constant over the last 15 years, but yields have increased substantially from around 10 ton/ha in years 1990s to almost 25 ton/ha currently.

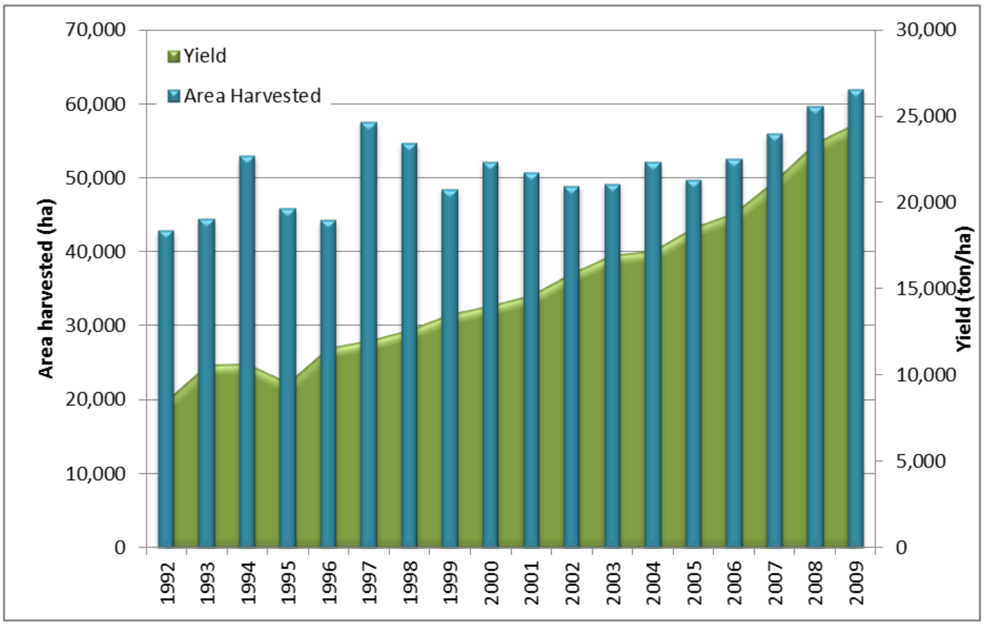


Figure 6. Potato fresh yield and harvested area during the last 18 years in Uzbekistan (source: FAOSTAT)

Crop parameters

The AquaCrop data file for potatoes has been created by adjusting parameters in order to represent average local conditions in Uzbekistan. The most important assumptions and crop information used to parameterize the crop files in AquaCrop are:

- Planting date: 1 May
- Harvest date: end of August
- Dry matter content harvested product: 25%
- Yields: 25 ton/ha (fresh yield) (= 6 ton/ha dry)
- Irrigation: 100%
- Irrigation method: furrow
- Irrigation application: 450 mm
- Harvest index = 75%

2.4.6 Tomatoes

The existing pre-calibrated tomato crop file was changed by altering the less conservative parameters in order to tailor the crop parameters to the Uzbek situation. It was assumed that the crop is planted at the start of April and harvested in half July. Total water requirements (ETm) after transplanting, of a tomato crop grown in the field for 90 to 120 days, are 400 to 600 mm, depending on the climate. In Uzbekistan, tomatoes are normally irrigated. Amounts of 1l/s/ha are normal, resulting in about 300 mm for the entire growth season. Being a relatively intensive crop, the applied fertilizer amounts were assumed to be nearly optimal in Uzbekistan, with a fertility stress level of 20%.

A good commercial yield under irrigation is 45 to 65 tons/ha fresh fruit, of which around 85 - 95 percent is moisture. For this study it was assumed that dry matter content is 15%. According to FAOSTAT, yields in Uzbekistan are above the world average, but relatively low compared to the main producing countries around the Mediterranean Sea (Spain, Italy, etc). In Uzbekistan, fresh yields between 25 and 35 ton/ha are common, according to local statistics and FAOSTAT.

The fertilizer requirements amount, for high producing varieties, to 100 to 150 kg/ha N, 65 to 110 kg/ha P and 160 to 240 kg/ha K.

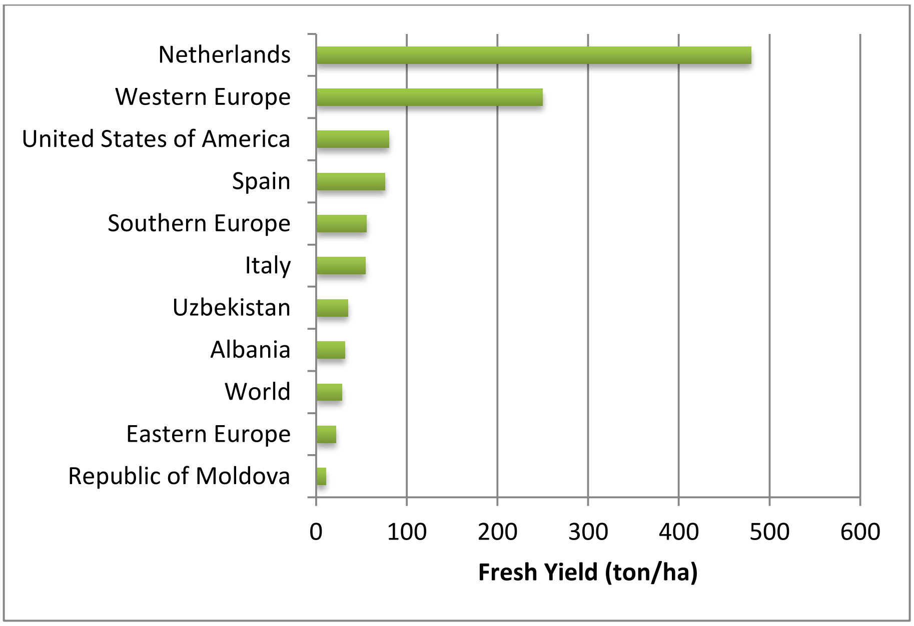


Figure 7. Tomato fresh yield in some selected relevant countries.

Crop parameters
The AquaCrop data file for tomatoes has been created by adjusting non-conservative parameters of the existing crop file to the local conditions in the country. The most important assumptions and crop information used to parameterize the crop file in AquaCrop are:

- Planting date: start April
- Harvest date: half July
- Dry matter content harvested product: 15%
- Irrigation: 100%
- Irrigation method: furrow
- Irrigation application: 300 mm
- Fertilizer status: near-optimal, stress level 20%
- Harvest index: 63%

2.4.7 Wheat

The pre-calibrated wheat crop file in AquaCrop required small changes to adapt it to the Uzbek situation. The different existing wheat varieties can be grouped as winter or spring type. Winter wheat requires a cold period or chilling during early growth for normal heading under long days and is in many cases cultivated in Uzbekistan rotating with cotton. Being cultivated in the winter, hardly any or no irrigation is required. Spring wheat is planted around March and harvested at the end of July and requires considerable irrigation. This type was studied being most relevant in terms of the impact on the water resources.

It was assumed that in Uzbekistan a density of 450000 plants/ha is common. Irrigation amounts of 100-200 mm were assumed to be representative for Uzbek irrigation practices for spring wheat and for winter wheat 50mm more as an initial irrigation at the start of the growing season. For good yields the fertilizer requirements are up to 150 kg/ha N, 35 to 45 kg/ha P and 25 to 50 kg/ha K. In Uzbekistan, it was assumed that fertility status of the soils was non-optimal (40%), due to the poor and salt-stressed conditions.

Under irrigation a good commercial grain yield is 6 to 9 ton/ha (10 to 13 percent moisture). In this study a dry matter content of 87% was assumed. In Uzbekistan between 4 and 5 ton/ha is reached.

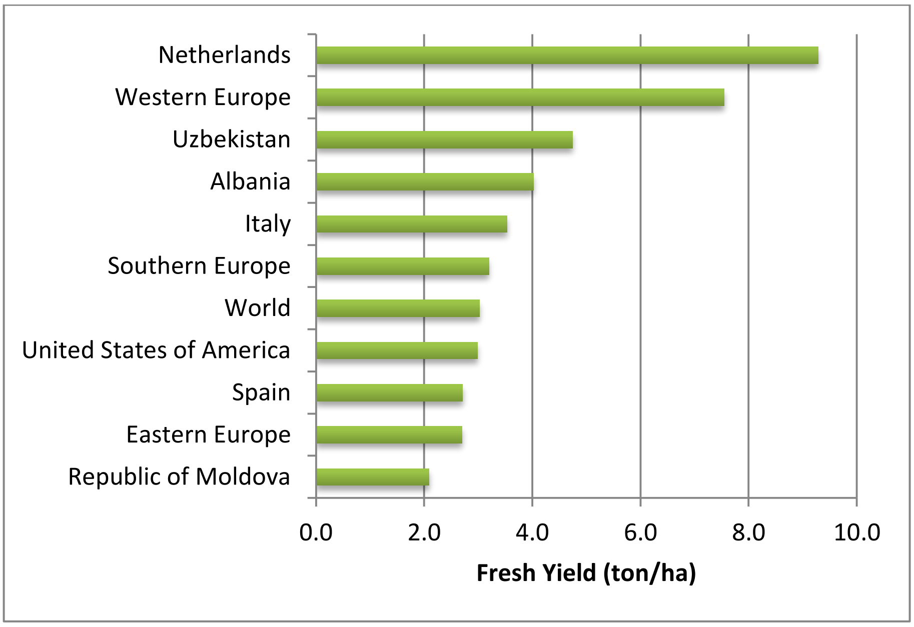


Figure 8. Wheat fresh yield in some selected relevant countries,

Crop parameters

The AquaCrop data file for wheat has been created by adjusting parameters in order to represent average local conditions in Uzbekistan. The most important assumptions and crop information used to parameterize the crop files in AquaCrop are:

- Planting date: half of March
- Harvest date: end of July
- Dry matter content harvested product: 87%
- Yields: between 4 and 5 ton/ha (fresh yield)
- Irrigation: 100%
- Irrigation method: furrow
- Irrigation application: 100-200 mm
- Harvest index = 48%

3 Results Impact Assessment

3.1 Crop Yields

Detailed results for each combination of (i) crop (ii) AEZ (iii) climate and (iv) CO_2 are given in the two appendices. Appendix A shows the impact of climate change on crop yields assuming that the irrigation application remains the same as under current conditions. In Appendix B the changes of irrigation requirements under climate change are given for those crops that are irrigated in Uzbekistan. In this Chapter these results are summarized and briefly discussed. The Chapter will start with a summary table of impact of climate change on crop yields and irrigation water requirements for each climate change scenario (low, medium and high).

Table 2 to Table 4 list the yield changes relative to the reference situation, expressed in %/ 10 year. The red color indicates a decrease in yield, compared to the current situation, while the green color indicates an increase in yield. This was calculated by taking the average percentual change for each of the four periods (2010s, 2020s, 2030s and 2040s) relative to the current situation. It has to be noted that these percentual changes in many cases cannot be summed to reach to a total percentage over f.e. 40 years, because for some crops, AEZs and scenarios, the changes do not show a linear trend. This can also be clearly observed in the tables and figures of Appendix A.

Table 2. Yield changes relative to the current situation (%/10yr) under the LOW climate scenario, for each crop and AEZ (assuming no CO2 fertilization)

Crop	Desert & Steppe RB 2	Desert & Steppe RB 5	Highlands RB 3	Piedmont zone RB 1	Piedmont zone RB 3
Alfalfa	3%	2%	2%	9%	2%
Apples	0%	-2%	0%	-1%	-1%
Cotton	0%	-2%		-2%	1%
Grassland	16%	12%	7%	9%	10%
Potatoes	1%	-1%	0%	-1%	1%
Tomatoes	2%	-1%		-1%	3%
Winter wheat	5%	3%	2%	7%	1%
Spring wheat	1%	1%	-2%	2%	0%

Table 3. Yield changes relative to the current situation (%/10yr) under MEDIAN climate scenario, for each crop and AEZ (assuming no CO2 fertilization)

Crop	Desert & Steppe RB 2	Desert & Steppe RB 5	Highlands RB 3	Piedmont zone RB 1	Piedmont zone RB 3
Alfalfa	3%	2%	3%	10%	2%
Apples	-2%	-2%	-1%	-2%	-2%
Cotton	`	-2%		-1%	-1%
Grassland	12%	11%	14%	17%	9%
Potatoes	-1%	-2%	-1%	0%	-1%
Tomatoes	-1%	-2%		0%	0%
Winter wheat	1%	1%	0%	6%	-1%
Spring wheat	-1%	-1%	-1%	2%	-2%

Table 4. Yield changes relative to the current situation (%/10yr) under HIGH climate scenario, for each crop and AEZ (assuming no CO2 fertilization)

Crop	Desert & Steppe RB 2	Desert & Steppe RB 5	Highlands RB 3	Piedmont zone RB 1	Piedmont zone RB 3
Alfalfa	0%	0%	0%	9%	0%
Apples	-6%	-5%	-6%	-6%	-6%
Cotton	-3%	-3%		-3%	-3%
Grassland	0%	-6%	-1%	8%	-3%
Potatoes	-3%	-3%	-4%	-3%	-4%
Tomatoes	-4%	-3%		-2%	-6%
Winter wheat	-3%	-1%	-1%	6%	-6%
Spring wheat	-8%	-4%	-10%	-1%	-9%

The previous tables show that only small negative impacts can be foreseen for most crops for the low and median climate scenario, except for alfalfa and grasslands. For these two crops, the higher temperatures at the start and the end of the season have a net positive impact on yields. For grasslands the yields are also enhanced by the slightly higher rainfall amounts predicted for the median and low climate scenario. Generally speaking, the impacts are small for both the low as the median scenario and are rather similar.

For the high climate scenario, yields are affected negatively by the lower rainfall amounts predicted for this scenario. This leads to more water stress and growth is limited, both for the rainfed as well as the irrigated crops, assuming same irrigation amounts.

3.2 Crop Water Requirements

Of the irrigated crops, the climate impact on irrigation amounts was assessed, assuming same future yields. The following tables summarize for each of the crops the results. In the appendix the full results can be found for each crop and AEZ. The orange color indicates an increase in crop irrigation water requirements, while green indicates a decrease.

Again, the following tables were calculated by taking the average percentual change for each of the four periods (2010s, 2020s, 2030s and 2040s) relative to the current situation. As in many cases, the changes do not show a linear trend, these percentual changes can mostly not be summed to obtain a total percentage over f.e. 40 years, because for some crops, AEZs and scenarios. This can be clearly observed in the tables and figures of Appendix B, where the changes for each decade are shown.

Table 5. Irrigation water requirements changes relative to current situation (%/10yr) under the 3 climate scenarios, for each crop and AEZ (assuming no CO2 fertilization)

Scenario	Crop	Desert & Steppe RB 2	Desert & Steppe RB 5	Highlands RB 3	Piedmont zone RB 1	Piedmont zone RB 3
LOW	Alfalfa	-3%	-3%	-4%	-17%	-2%
	Apples	4%	3%	2%	6%	3%
	Cotton	2%	4%		3%	2%
	Potatoes	2%	3%	1%	4%	0%
	Tomatoes	-1%	0%		-2%	-2%
	Winter wheat	4%	-2%	-1%	-2%	4%
	Spring wheat	4%	2%	3%	-17%	4%
MEDIAN	Alfalfa	-4%	-3%	-3%	-16%	-2%
	Apples	1%	3%	1%	6%	1%
	Cotton	-1%	3%		4%	-2%
	Potatoes	-1%	2%	0%	7%	-3%
	Tomatoes	-4%	-2%		0%	-5%
	Winter wheat	4%	1%	1%	-11%	6%
	Spring wheat	2%	0%	4%	-19%	2%
HIGH	Alfalfa	1%	0%	1%	-15%	1%
	Apples	9%	7%	10%	29%	9%
	Cotton	5%	5%		7%	6%
	Potatoes	6%	6%	8%	23%	6%
	Tomatoes	3%	3%		6%	5%
	Winter wheat	7%	2%	4%	11%	8%
	Spring wheat	12%	6%	14%	-7%	12%

For the high climate scenario, the overall trend is that more water is required to maintain the current yields. Especially apples and wheat will need substantial increased amounts of water (see also Appendix B for absolute numbers for each decade). For the other scenarios, the impacts are less severe, and only small changes can be expected in crop water requirements.

4 Results Adaptation Assessment

Several adaptation strategies were selected for Uzbekistan that may increase the national crop production. The potential for yield increase of these adaptation strategies was evaluated by assessing them with the crop process model AquaCrop. The following four adaptation options are addressed:

1) Increasing fertilizer application.

Several crops in Uzbekistan are currently cultivated while applying non-optimal amounts of fertilizers. This leaves a margin for yield increase in the future. The influence of more fertilizer use was assessed with the crop model and compared with the current situation. It was assumed that fertility stress can be reduced by 20% for crops that are currently cultivated using less than sub-optimal amounts of fertilizers. For crops which are currently grown under sub-optimal fertilizer conditions, it was assumed that there is a potential to reduce fertility stress by 10%.The sensitivity to these lower stress levels depend on the crop which is something that is accounted for in the model.

2) Enhanced varieties.

It is likely that future crop enhancements will lead to more water-efficient varieties. This will allow higher crop yields in the future. The crop model is used to assess the potential yield increases and the results were compared with the current situation. It was assumed that the crop water productivity can be enhanced in the future by 15%. The use of these varieties together with the different future climatic conditions would lead to changes in planting and harvest dates. It was assumed that these new enhanced varieties can be planted 7 days earlier and harvested 14 days earlier compared to the current situation. This leads to a total growing period which is 7 days shorter than the variety used in the impact assessment.

3) Increasing irrigation water application.

The current irrigation amounts applied to the crops are not equal to the full crop irrigation water requirements. Applying more water to the irrigated crops can enhance crop growth. The crop model was used to estimate the yields when applying 100 mm of additional water to the crops and the results were compared with the current situation.

4) Decreasing soil salinity

Building up of salt in the soil surface in irrigated areas in Uzbekistan causes a serious problem for agriculture. A technique to decrease soil salinity is to apply more water than the crop consumption and drive salt deeper underground beneath the fertile top soil. Heavier soils require larger water applications than lighter soils, in order to avoid salinity buildup. The benefit of lowering soil salinity for crop production depends on the salt tolerance of each crop. These tolerances were extracted from literature (Maas, 1990) and used to determine the relative benefit of increased soil fertility due to lower soil salinity.

Table 6. Impact on crop yields (ton/ha) of different adaptation options for the 5 AEZs

Scenario		Desert & Steppe RB 2	Desert & Steppe RB 5	Highlands RB 3	Piedmont zone RB 1	Piedmont zone RB 3
Alfalfa						
Current		**34.7**	**37.7**	**35.8**	**22.3**	**35.7**
2040's	Impact	35.6 (+3%)	38.5 (+2%)	37.0 (+3%)	27.2 (+22%)	36.1 (+1%)
	Increased Fertilizer Use	39.4 (+13%)	42.7 (+13%)	40.9 (+14%)	30.6 (+37%)	39.6 (+11%)
	Increased Irrigation	38.8 (+12%)	42.0 (+11%)	40.3 (+12%)	29.9 (+34%)	39.4 (+10%)
	Enhanced Varieties	39.5 (+14%)	41.9 (+11%)	40.7 (+13%)	30.2 (+35%)	40.2 (+13%)
	Decreased Soil Salinity	38.4 (+11%)	41.7 (+11%)	39.9 (+11%)	29.7 (+33%)	38.7 (+9%)
Apples						
Current		**6.5**	**7.1**	**7.1**	**7.6**	**6.1**
2040's	Impact	6.0 (-8%)	6.8 (-5%)	6.5 (-9%)	7.5 (-1%)	5.6 (-8%)
	Increased Fertilizer Use	6.1 (-6%)	6.8 (-4%)	6.6 (-7%)	7.9 (+3%)	5.8 (-5%)
	Increased Irrigation	7.5 (+16%)	8.5 (+19%)	8.1 (+13%)	8.5 (+12%)	7.1 (+16%)
	Enhanced Varieties	7.1 (+9%)	8.1 (+13%)	7.8 (+10%)	9.0 (+18%)	6.8 (+12%)
	Decreased Soil Salinity	6.0 (-7%)	6.8 (-5%)	6.5 (-8%)	7.7 (+1%)	5.7 (-7%)
Cotton						
Current		**2.8**	**2.9**		**3.2**	**2.6**
2040's	Impact	2.6 (-6%)	2.8 (-5%)		3.1 (-2%)	2.4 (-6%)
	Increased Fertilizer Use	2.8 (+0%)	2.9 (+0%)		3.3 (+6%)	2.6 (-2%)
	Increased Irrigation	3.0 (+7%)	3.2 (+9%)		3.4 (+9%)	2.8 (+8%)
	Enhanced Varieties	3.0 (+8%)	3.2 (+8%)		3.5 (+12%)	2.8 (+7%)
	Decreased Soil Salinity	2.6 (-5%)	2.8 (-4%)		3.2 (-0%)	2.5 (-5%)
Grassland						
Current		**4.6**	**4.0**	**4.9**	**3.7**	**4.8**
2040's	Impact	5.2 (+12%)	4.6 (+15%)	5.4 (+12%)	5.3 (+43%)	4.7 (-1%)
	Increased Fertilizer Use	5.2 (+13%)	4.8 (+19%)	5.5 (+13%)	5.4 (+46%)	4.7 (-0%)
	Increased Irrigation	6.0 (+30%)	5.1 (+26%)	6.6 (+35%)	5.9 (+60%)	6.1 (+28%)
	Enhanced Varieties	5.2 (+13%)	4.8 (+18%)	5.5 (+13%)	5.4 (+45%)	4.7 (-1%)
Potatoes						
Current		**22.7**	**24.0**	**23.6**	**21.4**	**21.4**
2040's	Impact	21.4 (-6%)	23.0 (-4%)	21.9 (-7%)	21.8 (+2%)	19.9 (-7%)
	Increased Fertilizer Use	25.1 (+10%)	26.4 (+10%)	26.2 (+11%)	26.8 (+25%)	22.8 (+6%)
	Increased Irrigation	25.4 (+12%)	28.0 (+16%)	26.0 (+10%)	25.0 (+17%)	24.6 (+15%)
	Enhanced Varieties	24.7 (+9%)	26.3 (+9%)	25.6 (+8%)	25.0 (+17%)	22.9 (+7%)
	Decreased Soil Salinity	24.2 (+6%)	25.6 (+6%)	25.1 (+6%)	25.6 (+19%)	22.1 (+3%)
Tomatoes						
Current		**32.3**	**33.8**		**37.2**	**30.0**
2040's	Impact	30.8 (-5%)	31.7 (-6%)		36.9 (-1%)	27.8 (-7%)
	Increased Fertilizer Use	31.7 (-2%)	32.8 (-3%)		39.5 (+6%)	29.0 (-3%)
	Increased Irrigation	37.7 (+17%)	41.2 (+22%)		41.2 (+11%)	36.5 (+21%)
	Enhanced Varieties	36.2 (+12%)	38.1 (+13%)		43.5 (+17%)	34.3 (+14%)
	Decreased Soil Salinity	31.5 (-2%)	32.5 (-4%)		38.8 (+4%)	28.7 (-4%)
Spring wheat						
Current		**4.1**	**4.2**	**4.6**	**4.2**	**3.7**
2040's	Impact	3.7 (-10%)	3.9 (-5%)	4.0 (-13%)	4.5 (+5%)	3.2 (-12%)
	Increased Fertilizer Use	3.7 (-9%)	4.1 (-1%)	4.1 (-11%)	5.2 (+24%)	3.3 (-11%)
	Increased Irrigation	5.5 (+35%)	5.7 (+37%)	5.8 (+28%)	5.5 (+29%)	5.0 (+37%)
	Enhanced Varieties	4.5 (+11%)	5.0 (+21%)	5.1 (+12%)	5.1 (+19%)	4.1 (+13%)
	Decreased Soil Salinity	3.7 (-9%)	4.0 (-3%)	4.0 (-12%)	4.9 (+14%)	3.2 (-12%)
Winter wheat						
Current		**4.9**	**4.7**	**5.1**	**3.7**	**5.0**
2040's	Impact	5.0 (+2%)	4.6 (-2%)	5.1 (-1%)	4.1 (+13%)	4.8 (-4%)
	Increased Fertilizer Use	5.4 (+10%)	5.1 (+9%)	5.7 (+11%)	5.1 (+39%)	5.0 (-0%)
	Increased Irrigation	6.7 (+38%)	6.3 (+34%)	6.6 (+28%)	4.6 (+25%)	6.7 (+35%)
	Enhanced Varieties	5.7 (+18%)	5.3 (+13%)	5.9 (+15%)	4.8 (+31%)	5.5 (+10%)
	Decreased Soil Salinity	5.2 (+6%)	4.9 (+4%)	5.4 (+5%)	4.6 (+26%)	4.9 (-2%)

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Climate Impact Assessment on Crop Production in Uzbekistan

Appendices

World Bank Study on Reducing Vulnerability to Climate Change in Europe and Central Asia (ECA) Agricultural Systems

February 2011

Client
World Bank

Author
J.E. Hunink
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A. Appendix - Impact on Crop Yields

A.1 **Alfalfa**

Figure 1-1. Yields for Alfalfa, AEZ: DS2 | No CO2 fert.

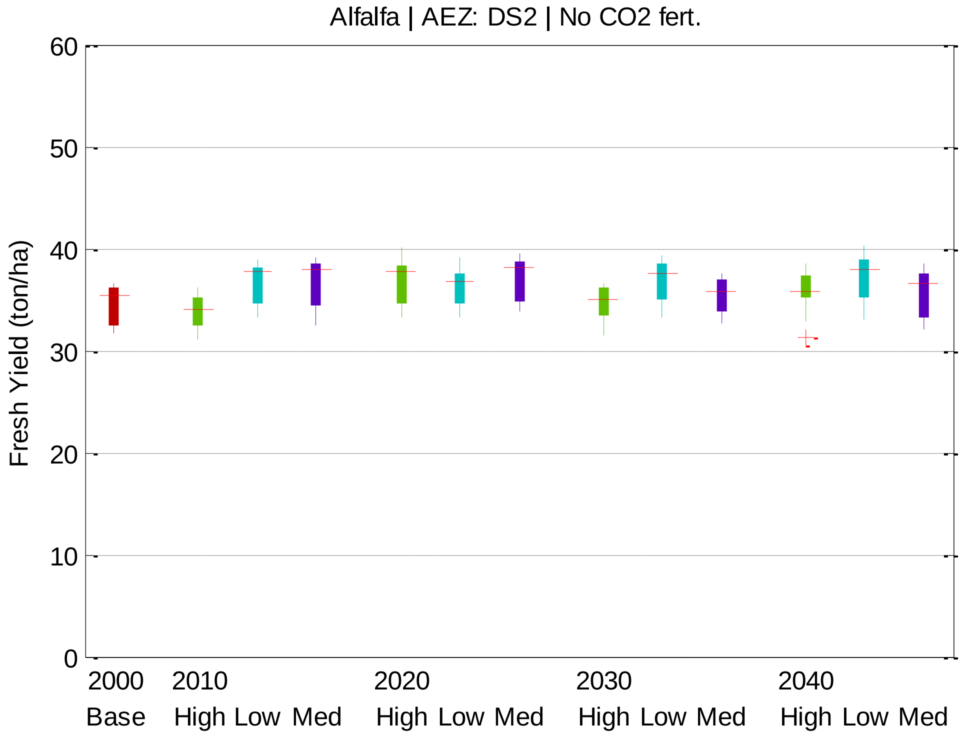

Table 1-1. Yield Statistics for Alfalfa, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	34.7	31.7	36.5	1.9
2010	High	33.9	31.1	36.1	1.6
2010	Low	36.8	33.3	38.9	2.1
2010	Med	36.7	32.4	39.2	2.4
2020	High	37.0	33.3	40.1	2.4
2020	Low	36.4	33.2	39.1	2.1
2020	Med	37.1	33.9	39.6	2.2
2030	High	34.6	31.5	36.6	1.8
2030	Low	36.8	33.2	39.4	2.2
2030	Med	35.5	32.6	37.6	1.8
2040	High	35.7	31.3	38.6	2.3
2040	Low	37.1	33.0	40.2	2.5
2040	Med	35.6	32.0	38.5	2.3

Figure 1-2. Yields for Alfalfa, AEZ: DS2 | CO2 fert.

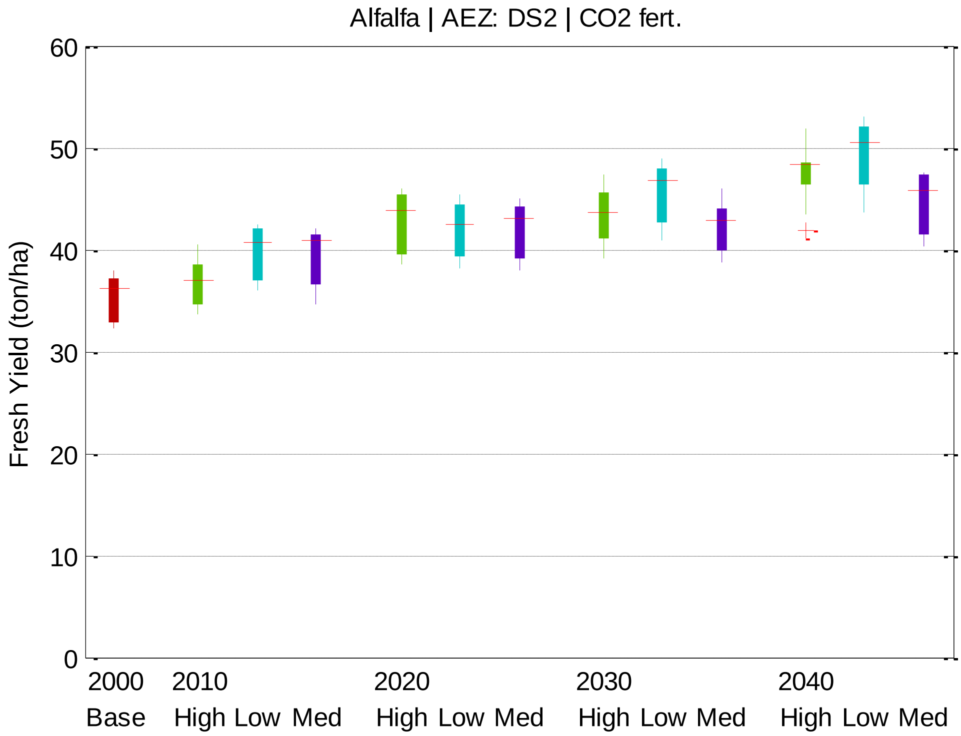

Table 1-2. Yield Statistics for Alfalfa, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	35.5	32.3	38.0	2.2
2010	High	36.8	33.6	40.4	2.2
2010	Low	39.8	35.9	42.5	2.5
2010	Med	39.4	34.7	42.0	2.8
2020	High	43.0	38.5	45.9	3.0
2020	Low	42.1	38.2	45.3	2.6
2020	Med	42.1	38.0	45.0	2.7
2030	High	43.2	39.1	47.3	2.7
2030	Low	45.7	40.9	49.0	3.0
2030	Med	42.4	38.8	46.0	2.3
2040	High	47.6	41.9	51.9	3.0
2040	Low	49.3	43.7	53.1	3.4
2040	Med	44.6	40.2	47.5	2.8

Figure 1-3. Yields for Alfalfa, AEZ: DS5 | No CO2 fert.

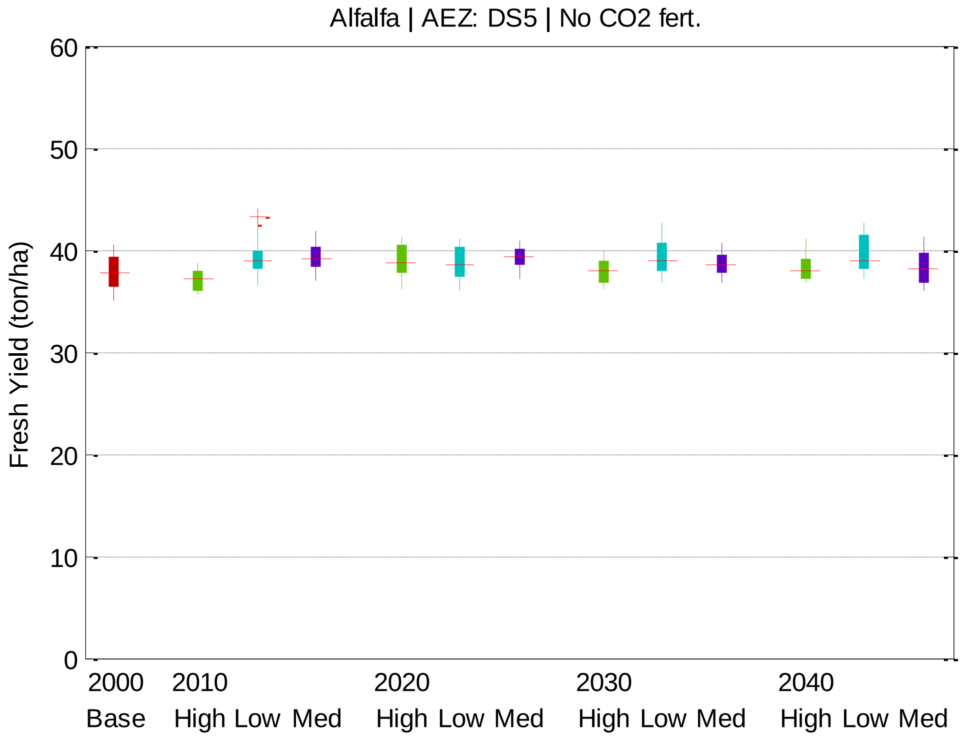

Table 1-3. Yield Statistics for Alfalfa, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	37.7	35.0	40.4	1.8
2010	High	37.1	35.6	38.7	1.2
2010	Low	39.3	36.5	43.2	2.1
2010	Med	39.3	36.9	41.8	1.6
2020	High	38.8	36.1	41.2	1.7
2020	Low	38.6	35.9	41.1	1.7
2020	Med	39.2	37.2	40.9	1.3
2030	High	37.9	36.2	39.9	1.3
2030	Low	39.1	36.7	42.6	1.9
2030	Med	38.6	36.7	40.7	1.4
2040	High	38.4	36.8	41.1	1.4
2040	Low	39.5	37.2	42.7	1.9
2040	Med	38.5	36.0	41.3	1.9

Figure 1-4. Yields for Alfalfa, AEZ: DS5 | CO2 fert.

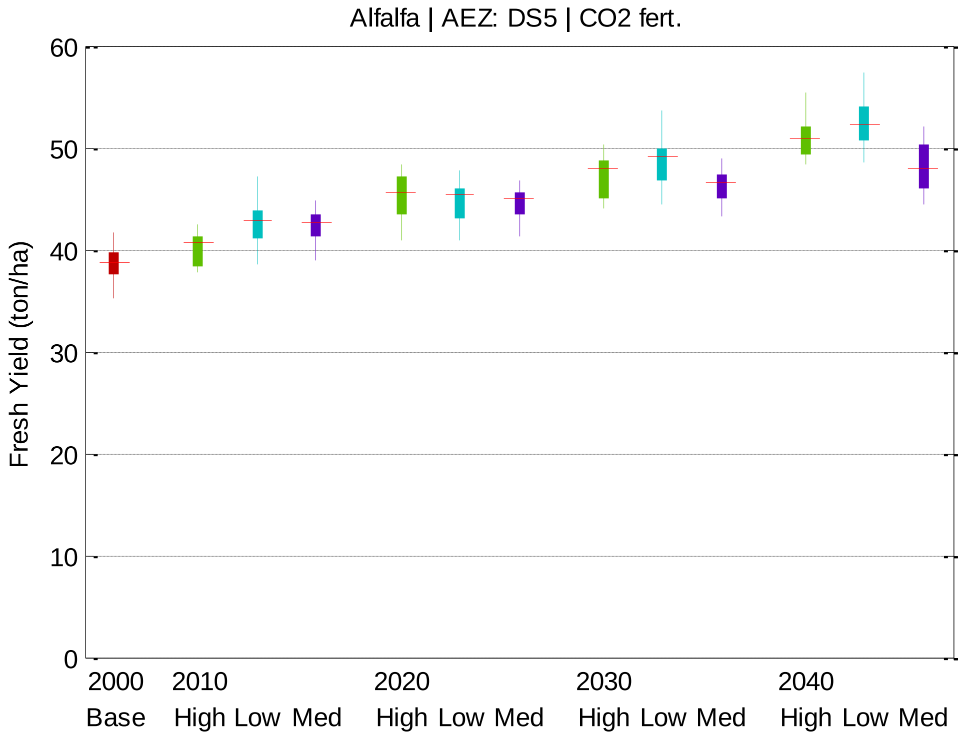

Table 1-4. Yield Statistics for Alfalfa, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	38.6	35.2	41.7	2.1
2010	High	40.3	37.7	42.4	1.6
2010	Low	42.5	38.6	47.1	2.6
2010	Med	42.2	38.9	44.9	1.9
2020	High	45.1	40.9	48.3	2.5
2020	Low	44.7	40.8	47.8	2.4
2020	Med	44.4	41.3	46.7	1.8
2030	High	47.3	44.1	50.3	2.1
2030	Low	48.6	44.4	53.6	2.8
2030	Med	46.2	43.3	49.0	1.8
2040	High	51.1	48.3	55.3	2.2
2040	Low	52.6	48.5	57.4	2.8
2040	Med	48.1	44.4	52.1	2.5

Figure 1-5. Yields for Alfalfa, AEZ: HI3 | No CO2 fert.

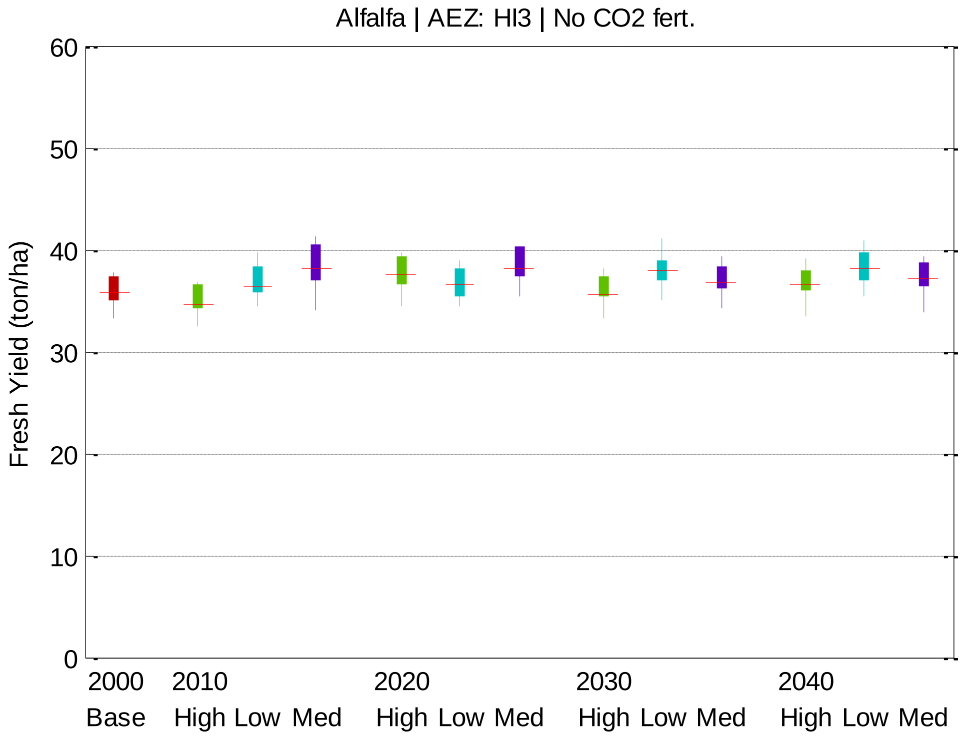

Table 1-5. Yield Statistics for Alfalfa, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	35.8	33.2	37.7	1.5
2010	High	35.0	32.4	36.8	1.4
2010	Low	37.1	34.4	39.8	1.8
2010	Med	38.2	34.0	41.2	2.3
2020	High	37.6	34.5	39.7	1.8
2020	Low	36.7	34.4	38.9	1.6
2020	Med	38.4	35.4	40.3	1.8
2030	High	36.0	33.3	38.2	1.5
2030	Low	38.0	35.0	41.0	1.9
2030	Med	37.1	34.3	39.4	1.6
2040	High	36.8	33.5	39.1	1.6
2040	Low	38.2	35.3	40.8	1.8
2040	Med	37.0	33.8	39.3	2.0

Figure 1-6. Yields for Alfalfa, AEZ: HI3 | CO2 fert.

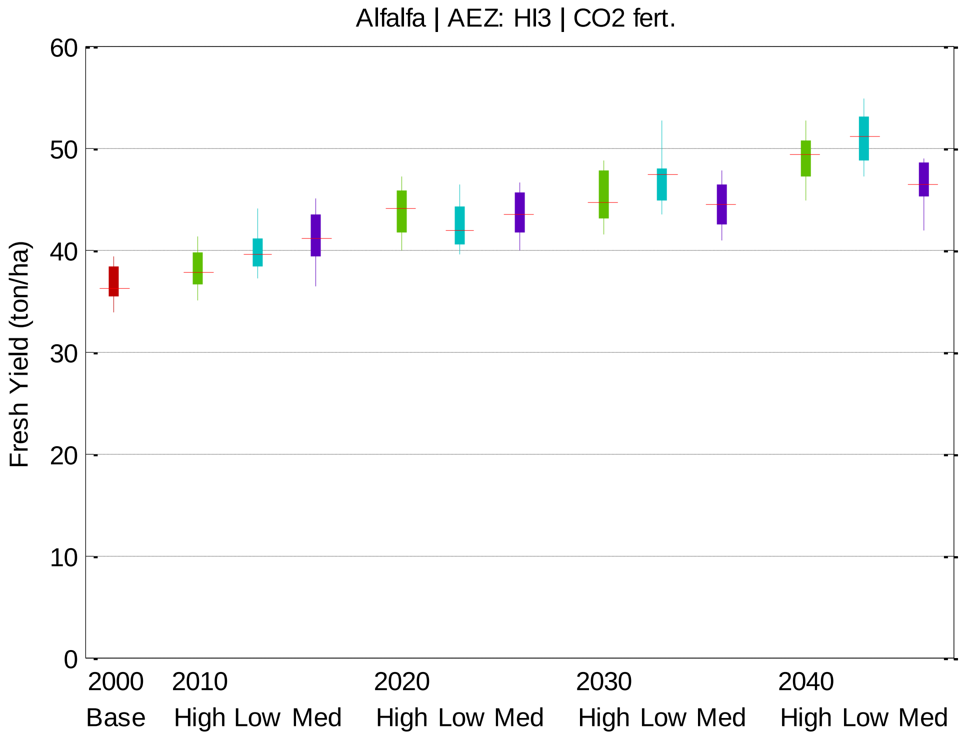

Table 1-6. Yield Statistics for Alfalfa, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	36.7	33.9	39.4	1.8
2010	High	38.0	35.0	41.2	2.0
2010	Low	40.1	37.1	44.0	2.4
2010	Med	41.1	36.4	45.0	2.7
2020	High	43.8	39.9	47.2	2.5
2020	Low	42.4	39.5	46.3	2.4
2020	Med	43.5	40.0	46.5	2.3
2030	High	44.9	41.4	48.8	2.5
2030	Low	47.3	43.4	52.7	3.0
2030	Med	44.3	40.8	47.8	2.2
2040	High	49.0	44.8	52.7	2.4
2040	Low	50.8	47.1	54.8	2.6
2040	Med	46.2	41.8	49.0	2.5

Figure 1-7. Yields for Alfalfa, AEZ: PI1 | No CO2 fert.

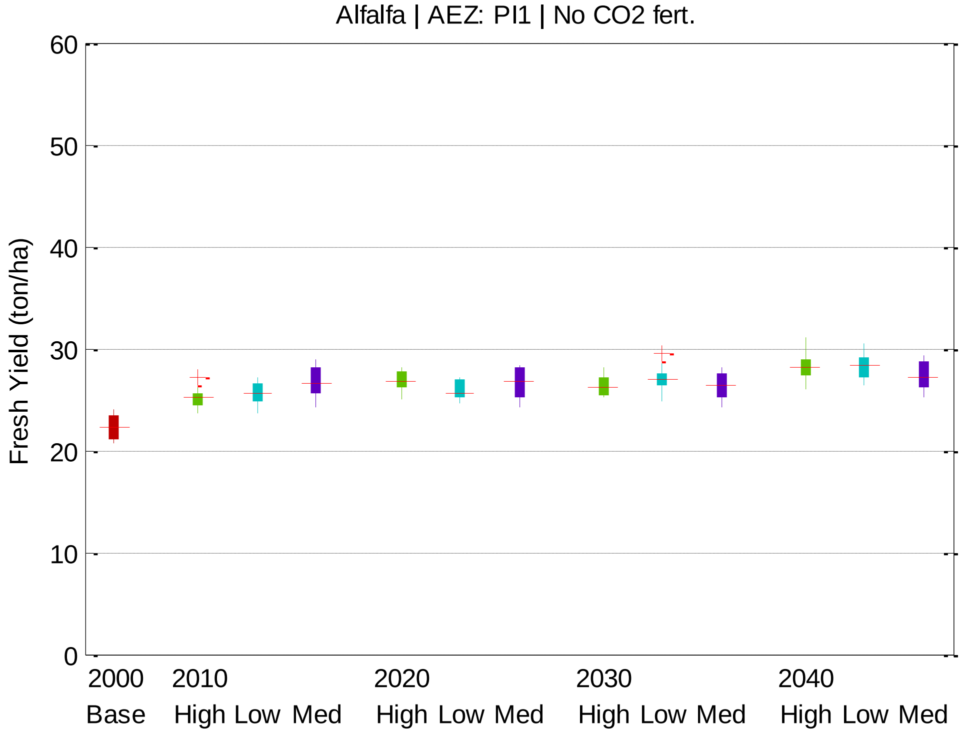

Table 1-7. Yield Statistics for Alfalfa, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	22.3	20.6	24.0	1.2
2010	High	25.2	23.7	27.2	1.0
2010	Low	25.6	23.7	27.2	1.1
2010	Med	26.7	24.2	28.9	1.5
2020	High	26.8	25.0	28.1	1.0
2020	Low	25.9	24.7	27.2	0.9
2020	Med	26.5	24.3	28.3	1.4
2030	High	26.3	25.2	28.1	1.0
2030	Low	27.0	24.9	29.6	1.3
2030	Med	26.3	24.3	28.1	1.3
2040	High	28.2	25.9	31.1	1.4
2040	Low	28.3	26.3	30.5	1.4
2040	Med	27.3	25.1	29.4	1.4

Figure 1-8. Yields for Alfalfa, AEZ: PI1 | CO2 fert.

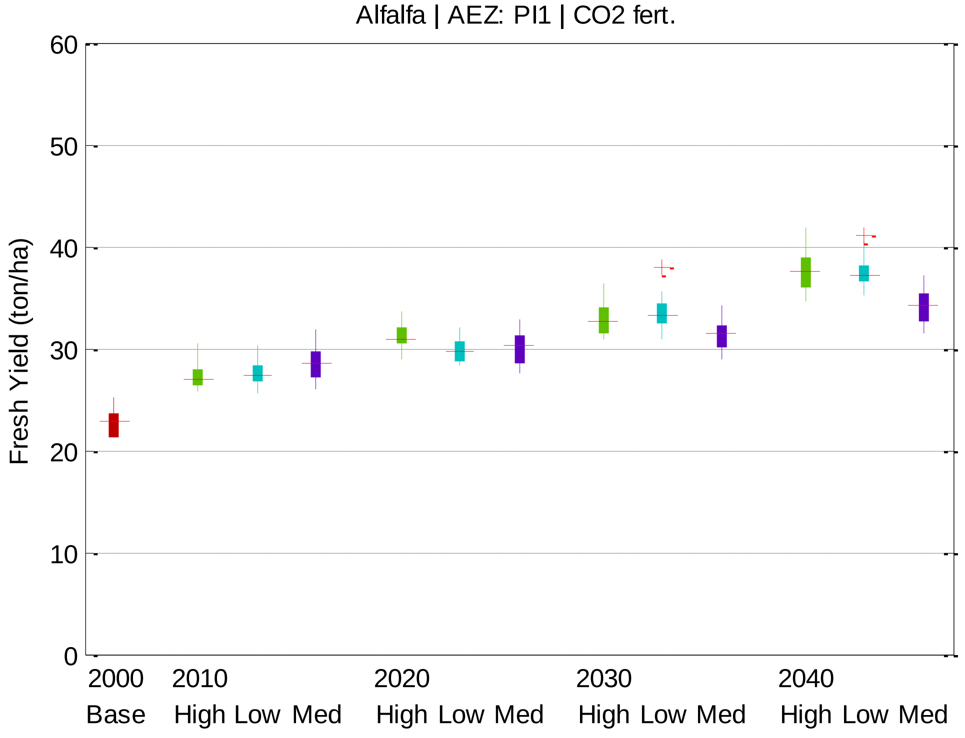

Table 1-8. Yield Statistics for Alfalfa, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	22.8	21.3	25.1	1.3
2010	High	27.4	25.7	30.5	1.4
2010	Low	27.7	25.5	30.2	1.4
2010	Med	28.6	25.9	31.8	1.8
2020	High	31.1	28.9	33.7	1.4
2020	Low	29.9	28.4	32.1	1.3
2020	Med	30.1	27.5	32.9	1.8
2030	High	32.9	30.9	36.3	1.6
2030	Low	33.6	30.8	38.0	2.0
2030	Med	31.4	28.9	34.3	1.6
2040	High	37.6	34.6	41.9	2.1
2040	Low	37.6	35.1	41.0	1.9
2040	Med	34.1	31.5	37.1	1.8

Figure 1-9. Yields for Alfalfa, AEZ: PI3 | No CO2 fert.

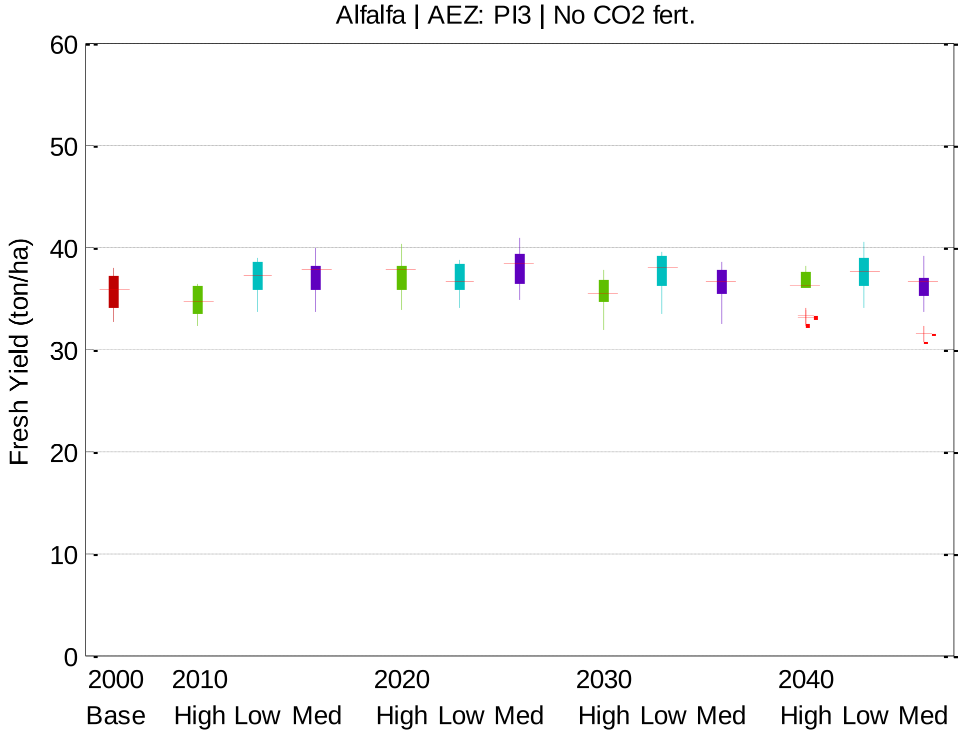

Table 1-9. Yield Statistics for Alfalfa, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	35.6	32.7	37.9	1.7
2010	High	34.6	32.2	36.4	1.5
2010	Low	36.8	33.7	39.0	1.8
2010	Med	37.1	33.7	40.0	2.1
2020	High	37.2	33.9	40.3	2.1
2020	Low	36.6	34.0	38.8	1.7
2020	Med	38.0	34.9	40.8	2.0
2030	High	35.2	31.8	37.7	1.9
2030	Low	37.4	33.4	39.6	2.1
2030	Med	36.1	32.5	38.5	1.9
2040	High	36.0	33.0	38.2	1.7
2040	Low	37.6	34.1	40.4	2.1
2040	Med	36.1	31.4	39.2	2.3

Figure 1-10. Yields for Alfalfa, AEZ: PI3 | CO2 fert.

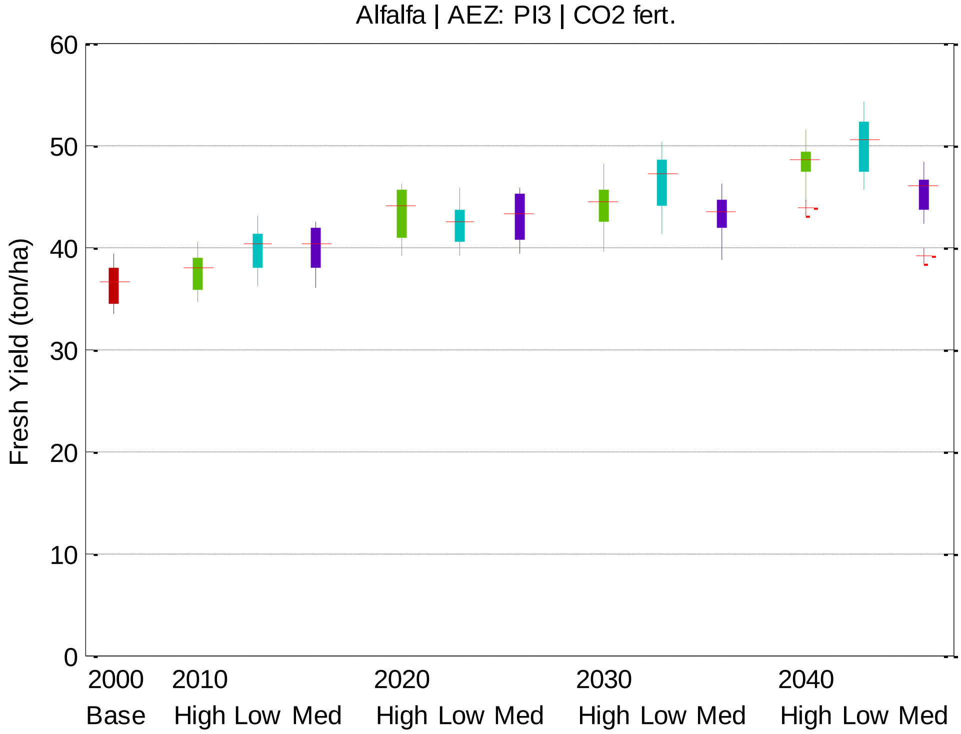

Table 1-10. Yield Statistics for Alfalfa, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	36.5	33.4	39.3	1.9
2010	High	37.6	34.7	40.4	1.9
2010	Low	39.8	36.1	43.0	2.2
2010	Med	39.9	35.9	42.4	2.3
2020	High	43.3	39.2	46.2	2.7
2020	Low	42.3	39.2	45.7	2.2
2020	Med	43.0	39.4	45.8	2.4
2030	High	44.0	39.6	48.2	2.7
2030	Low	46.5	41.3	50.3	2.9
2030	Med	43.2	38.7	46.1	2.5
2040	High	48.0	43.8	51.5	2.4
2040	Low	50.0	45.5	54.2	2.8
2040	Med	45.1	39.2	48.4	2.8

A.2 Apples

Figure 1-11. Yields for Apples, AEZ: DS2 | No CO2 fert.

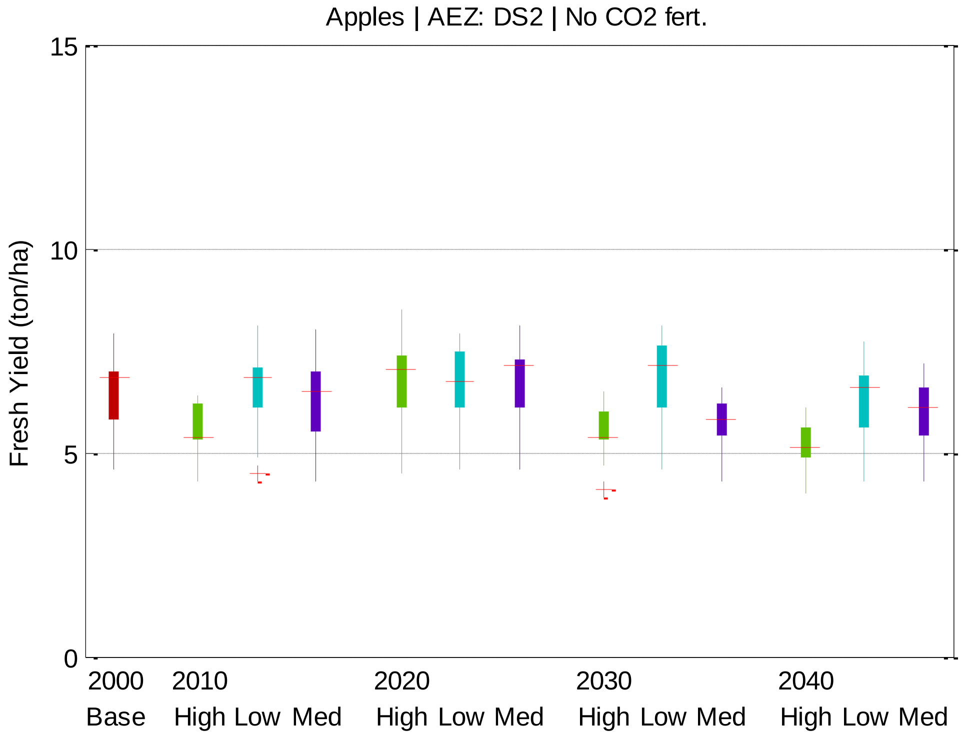

Table 1-11. Yield Statistics for Apples, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	6.5	4.6	7.9	1.0
2010	High	5.5	4.3	6.4	0.7
2010	Low	6.5	4.5	8.1	1.1
2010	Med	6.3	4.3	8.0	1.1
2020	High	6.7	4.5	8.5	1.2
2020	Low	6.5	4.6	7.9	1.1
2020	Med	6.6	4.6	8.1	1.2
2030	High	5.5	4.1	6.5	0.7
2030	Low	6.7	4.6	8.1	1.2
2030	Med	5.7	4.3	6.6	0.7
2040	High	5.1	4.0	6.1	0.6
2040	Low	6.3	4.3	7.7	1.1
2040	Med	6.0	4.3	7.2	1.0

Figure 1-12. Yields for Apples, AEZ: DS2 | CO2 fert.

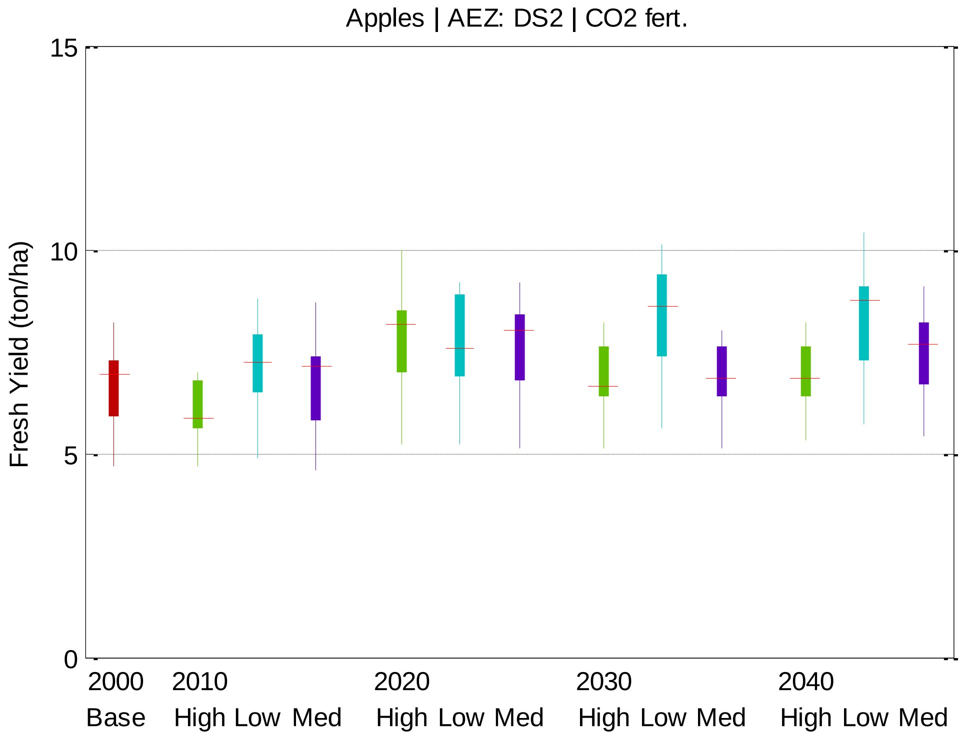

Table 1-12. Yield Statistics for Apples, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	6.7	4.7	8.2	1.1
2010	High	6.0	4.7	7.0	0.8
2010	Low	7.0	4.9	8.8	1.3
2010	Med	6.7	4.6	8.7	1.3
2020	High	7.8	5.2	10.0	1.5
2020	Low	7.5	5.2	9.2	1.4
2020	Med	7.5	5.1	9.2	1.4
2030	High	6.8	5.1	8.2	1.0
2030	Low	8.2	5.6	10.1	1.5
2030	Med	6.8	5.1	8.0	1.0
2040	High	6.8	5.3	8.2	0.9
2040	Low	8.3	5.7	10.4	1.5
2040	Med	7.5	5.4	9.1	1.2

Figure 1-13. Yields for Apples, AEZ: DS5 | No CO2 fert.

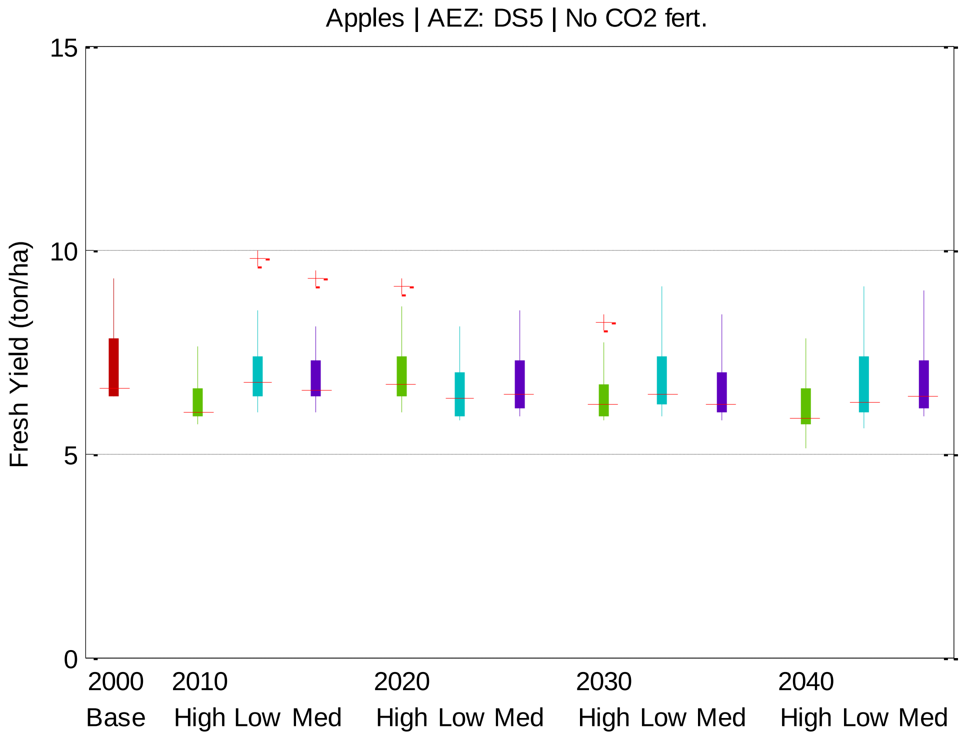

Table 1-13. Yield Statistics for Apples, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	7.1	6.4	9.3	1.0
2010	High	6.3	5.7	7.6	0.7
2010	Low	7.1	6.0	9.8	1.2
2010	Med	6.9	6.0	9.3	1.0
2020	High	7.1	6.0	9.1	1.0
2020	Low	6.6	5.8	8.1	0.9
2020	Med	6.7	5.9	8.5	0.8
2030	High	6.5	5.8	8.2	0.8
2030	Low	6.8	5.9	9.1	1.0
2030	Med	6.6	5.8	8.4	0.9
2040	High	6.1	5.1	7.8	0.8
2040	Low	6.7	5.6	9.1	1.1
2040	Med	6.8	5.9	9.0	1.0

Figure 1-14. Yields for Apples, AEZ: DS5 | CO2 fert.

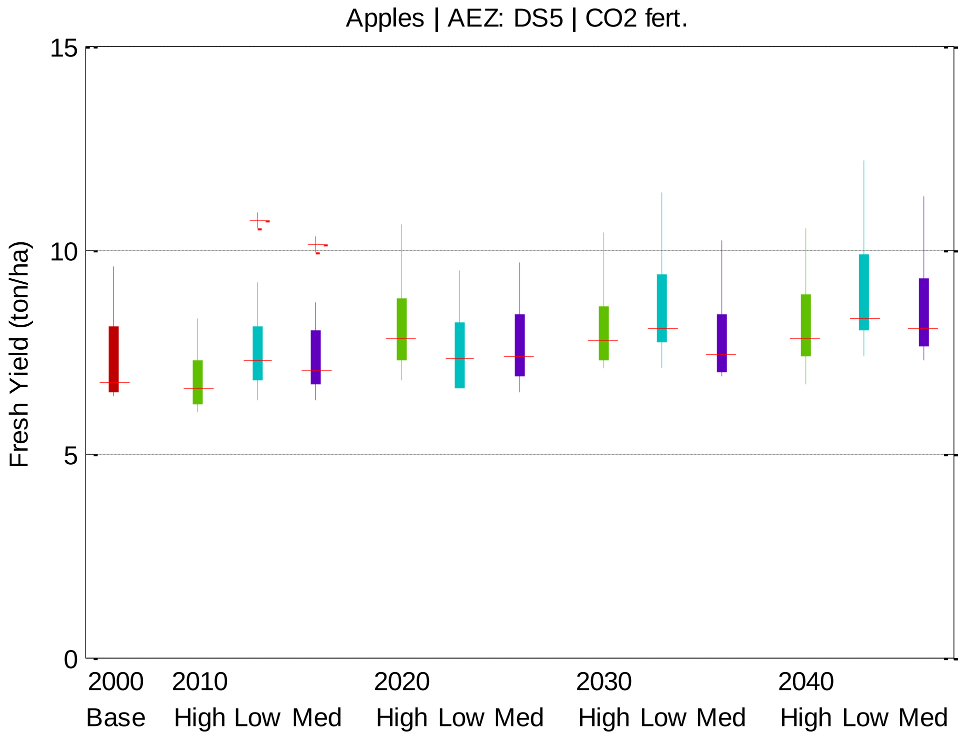

Table 1-14. Yield Statistics for Apples, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	7.3	6.4	9.6	1.1
2010	High	6.8	6.0	8.3	0.8
2010	Low	7.7	6.3	10.7	1.3
2010	Med	7.5	6.3	10.1	1.2
2020	High	8.2	6.8	10.6	1.2
2020	Low	7.6	6.6	9.5	1.1
2020	Med	7.7	6.5	9.7	1.0
2030	High	8.2	7.1	10.4	1.1
2030	Low	8.5	7.1	11.4	1.3
2030	Med	7.9	6.9	10.2	1.1
2040	High	8.2	6.7	10.5	1.2
2040	Low	8.9	7.4	12.2	1.5
2040	Med	8.5	7.3	11.3	1.3

Figure 1-15. Yields for Apples, AEZ: HI3 | No CO2 fert.

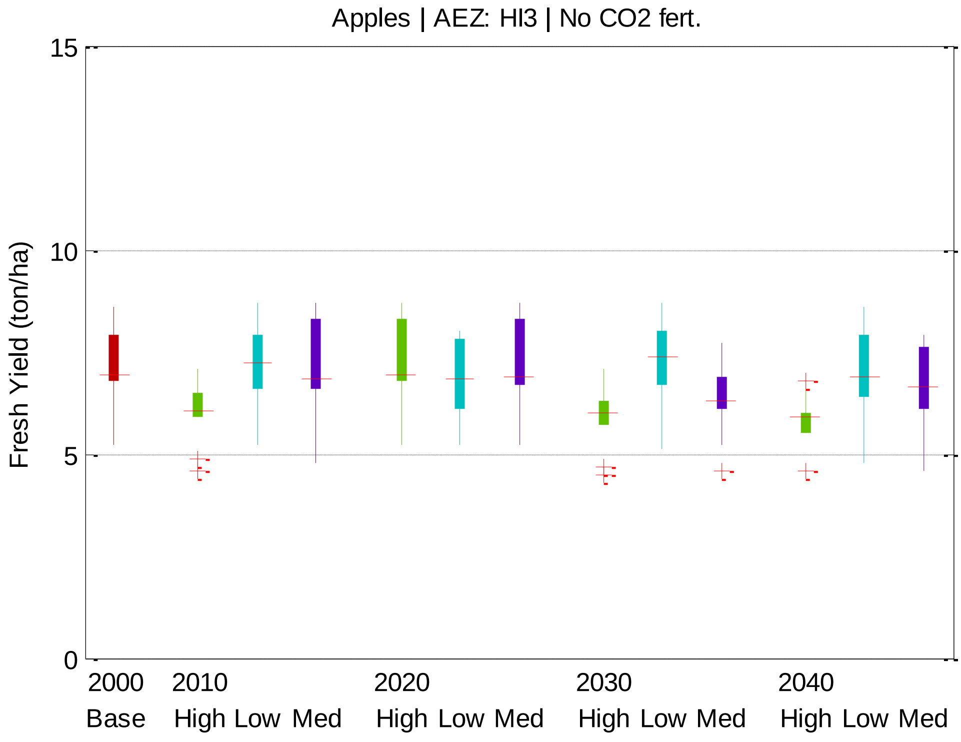

Table 1-15. Yield Statistics for Apples, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	7.1	5.2	8.6	1.1
2010	High	6.0	4.6	7.1	0.8
2010	Low	7.1	5.2	8.7	1.2
2010	Med	7.1	4.8	8.7	1.4
2020	High	7.2	5.2	8.7	1.3
2020	Low	6.8	5.2	8.0	1.0
2020	Med	7.2	5.2	8.7	1.2
2030	High	5.9	4.5	7.1	0.8
2030	Low	7.2	5.1	8.7	1.2
2030	Med	6.4	4.6	7.7	1.0
2040	High	5.8	4.6	6.8	0.7
2040	Low	7.0	4.8	8.6	1.2
2040	Med	6.5	4.6	7.9	1.2

Figure 1-16. Yields for Apples, AEZ: HI3 | CO2 fert.

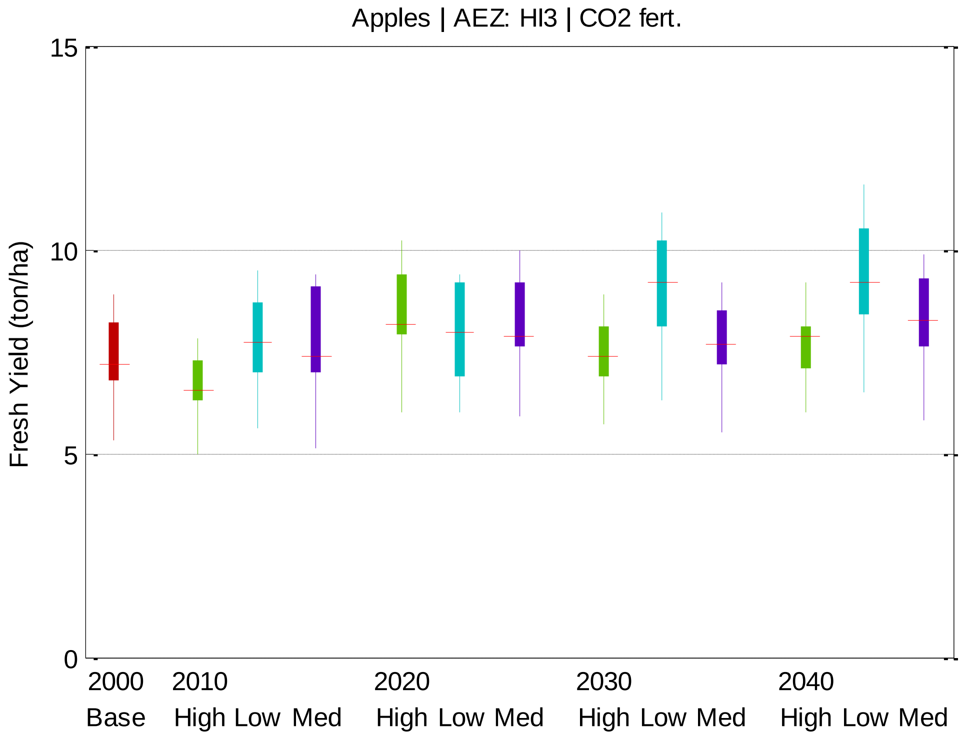

Table 1-16. Yield Statistics for Apples, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	7.3	5.3	8.9	1.2
2010	High	6.6	5.0	7.8	0.9
2010	Low	7.7	5.6	9.5	1.3
2010	Med	7.6	5.1	9.4	1.5
2020	High	8.3	6.0	10.2	1.5
2020	Low	7.9	6.0	9.4	1.2
2020	Med	8.1	5.9	10.0	1.4
2030	High	7.4	5.7	8.9	1.1
2030	Low	9.0	6.3	10.9	1.6
2030	Med	7.6	5.5	9.2	1.2
2040	High	7.7	6.0	9.2	1.0
2040	Low	9.3	6.5	11.6	1.6
2040	Med	8.1	5.8	9.9	1.5

Figure 1-17. Yields for Apples, AEZ: PI1 | No CO2 fert.

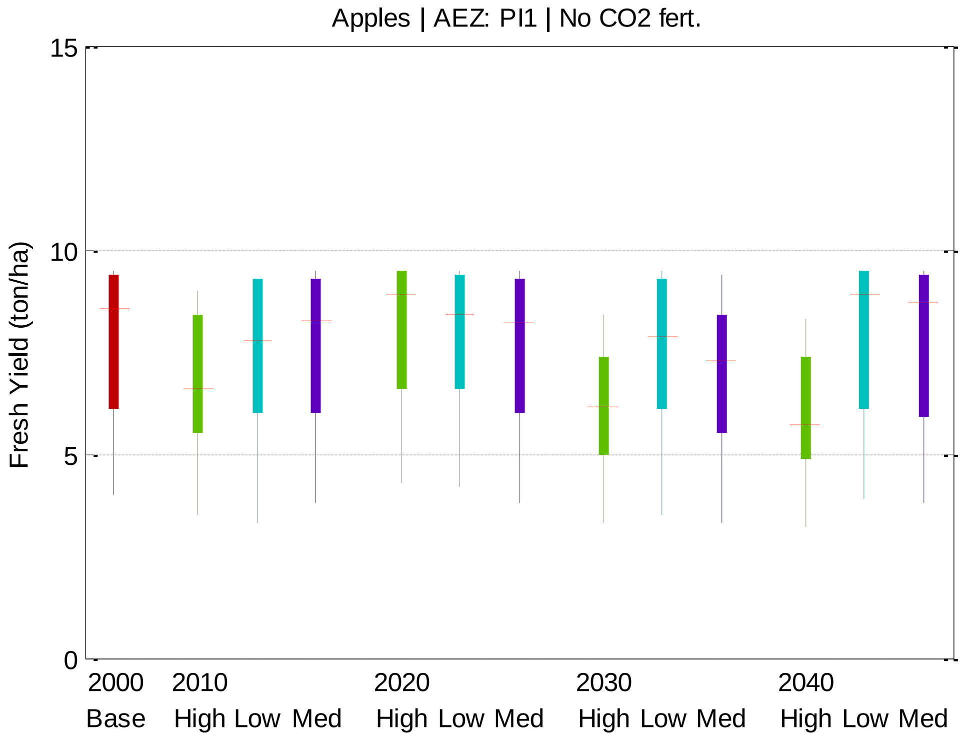

Table 1-17. Yield Statistics for Apples, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	7.6	4.0	9.5	2.1
2010	High	6.5	3.5	9.0	2.0
2010	Low	7.2	3.3	9.3	2.2
2010	Med	7.4	3.8	9.5	2.2
2020	High	7.8	4.3	9.5	2.1
2020	Low	7.7	4.2	9.5	2.0
2020	Med	7.4	3.8	9.5	2.2
2030	High	6.0	3.3	8.4	1.8
2030	Low	7.3	3.5	9.5	2.2
2030	Med	6.8	3.3	9.4	2.1
2040	High	5.8	3.2	8.3	1.7
2040	Low	7.8	3.9	9.5	2.2
2040	Med	7.5	3.8	9.5	2.3

Figure 1-18. Yields for Apples, AEZ: PI1 | CO2 fert.

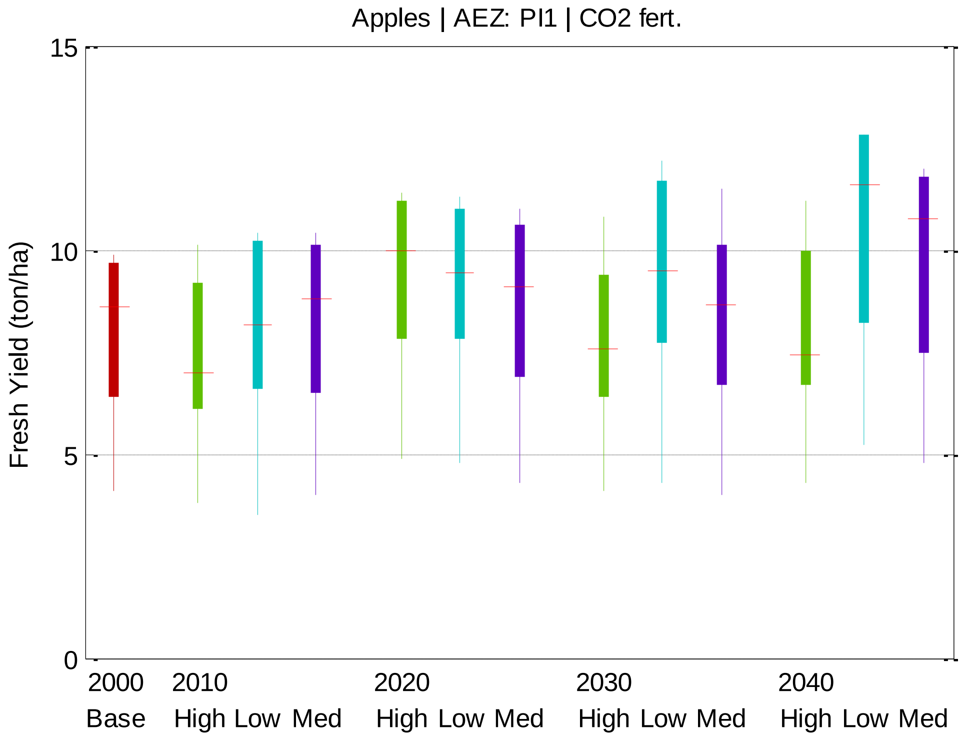

Table 1-18. Yield Statistics for Apples, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	7.8	4.1	9.9	2.2
2010	High	7.1	3.8	10.1	2.2
2010	Low	7.8	3.5	10.4	2.4
2010	Med	8.0	4.0	10.4	2.5
2020	High	9.0	4.9	11.4	2.5
2020	Low	8.9	4.8	11.3	2.4
2020	Med	8.4	4.3	11.0	2.5
2030	High	7.6	4.1	10.8	2.3
2030	Low	9.1	4.3	12.2	2.8
2030	Med	8.1	4.0	11.5	2.5
2040	High	7.7	4.3	11.2	2.3
2040	Low	10.3	5.2	12.8	3.0
2040	Med	9.4	4.8	12.0	2.8

Figure 1-19. Yields for Apples, AEZ: PI3 | No CO2 fert.

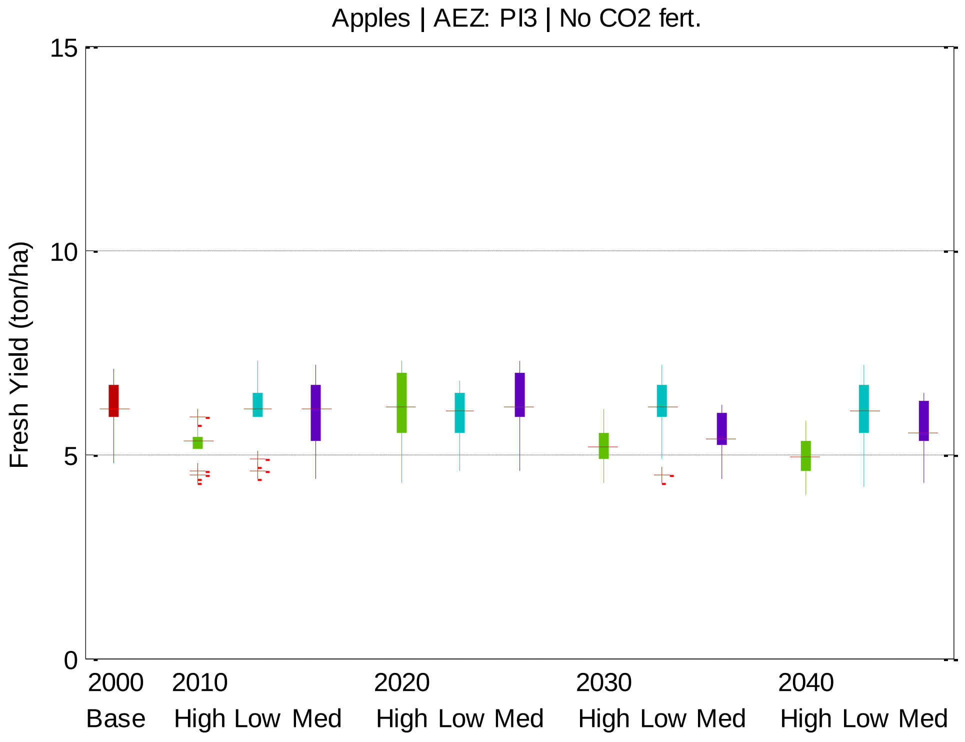

Table 1-19. Yield Statistics for Apples, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	6.1	4.8	7.1	0.7
2010	High	5.2	4.5	5.9	0.4
2010	Low	6.1	4.6	7.3	0.9
2010	Med	5.9	4.4	7.2	0.9
2020	High	6.0	4.3	7.3	1.0
2020	Low	5.9	4.6	6.8	0.7
2020	Med	6.2	4.6	7.3	0.9
2030	High	5.1	4.3	6.1	0.5
2030	Low	6.1	4.5	7.2	0.9
2030	Med	5.4	4.4	6.2	0.6
2040	High	4.9	4.0	5.8	0.5
2040	Low	5.9	4.2	7.2	0.9
2040	Med	5.6	4.3	6.5	0.7

Figure 1-20. Yields for Apples, AEZ: PI3 | CO2 fert.

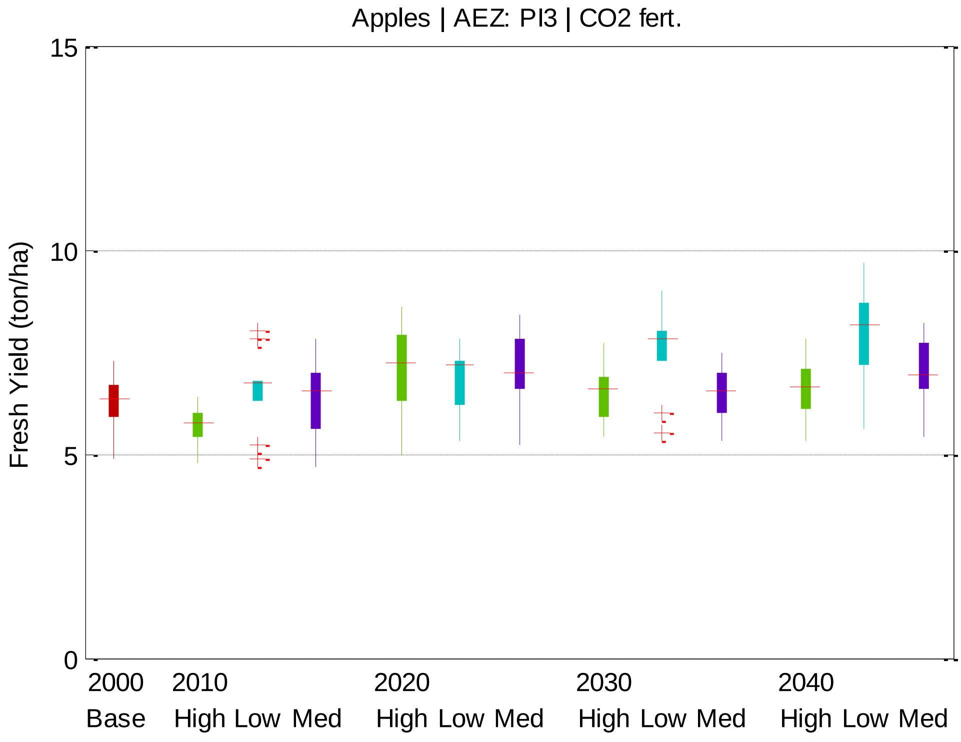

Table 1-20. Yield Statistics for Apples, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	6.2	4.9	7.3	0.8
2010	High	5.7	4.8	6.4	0.5
2010	Low	6.6	4.9	8.0	1.0
2010	Med	6.3	4.7	7.8	1.0
2020	High	7.0	5.0	8.6	1.2
2020	Low	6.8	5.3	7.8	0.9
2020	Med	7.0	5.2	8.4	1.0
2030	High	6.4	5.4	7.7	0.7
2030	Low	7.6	5.5	9.0	1.1
2030	Med	6.5	5.3	7.5	0.7
2040	High	6.6	5.3	7.8	0.7
2040	Low	7.9	5.6	9.7	1.3
2040	Med	7.0	5.4	8.2	0.9

A.3 **Cotton**

Figure 1-21. Yields for Cotton, AEZ: DS2 | No CO2 fert.

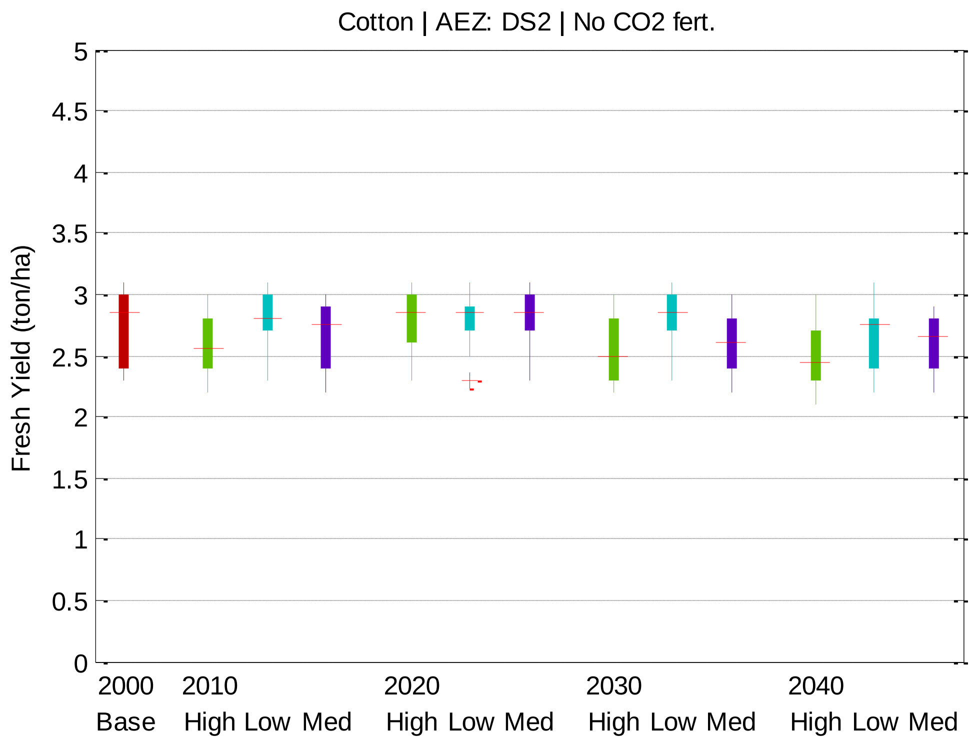

Table 1-21. Yield Statistics for Cotton, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	2.8	2.3	3.1	0.3
2010	High	2.6	2.2	3.0	0.3
2010	Low	2.8	2.3	3.1	0.3
2010	Med	2.7	2.2	3.0	0.3
2020	High	2.8	2.3	3.1	0.3
2020	Low	2.8	2.3	3.1	0.2
2020	Med	2.8	2.3	3.1	0.3
2030	High	2.5	2.2	3.0	0.3
2030	Low	2.8	2.3	3.1	0.2
2030	Med	2.6	2.2	3.0	0.3
2040	High	2.5	2.1	3.0	0.3
2040	Low	2.7	2.2	3.1	0.3
2040	Med	2.6	2.2	2.9	0.2

Figure 1-22. Yields for Cotton, AEZ: DS2 | CO2 fert.

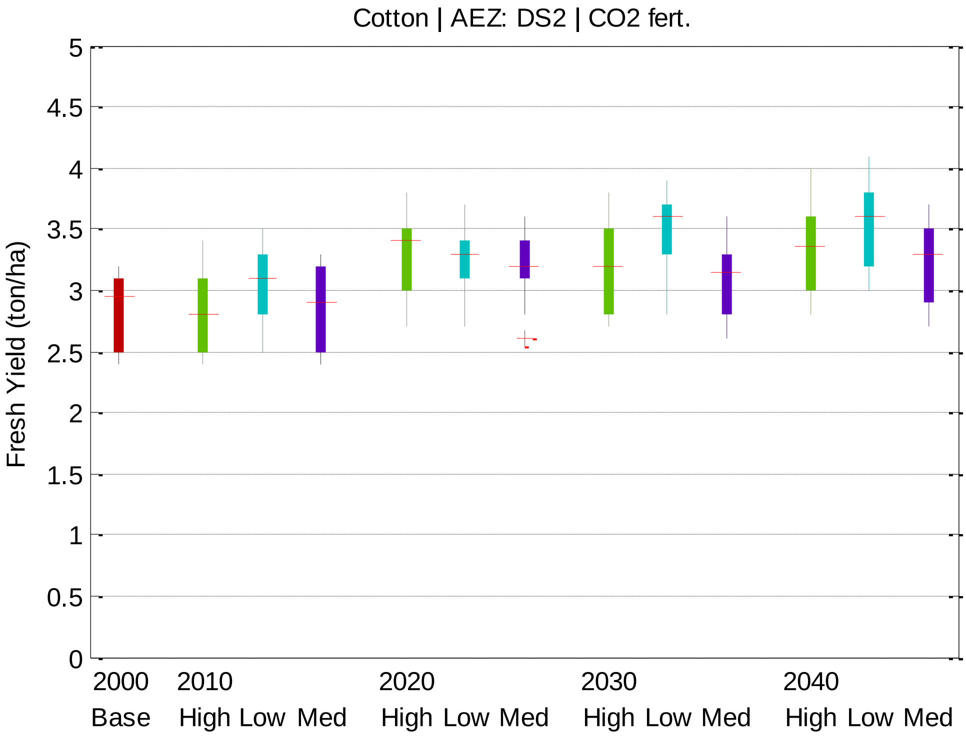

Table 1-22. Yield Statistics for Cotton, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	2.8	2.4	3.2	0.3
2010	High	2.8	2.4	3.4	0.3
2010	Low	3.0	2.5	3.5	0.3
2010	Med	2.9	2.4	3.3	0.3
2020	High	3.3	2.7	3.8	0.3
2020	Low	3.3	2.7	3.7	0.3
2020	Med	3.2	2.6	3.6	0.3
2030	High	3.2	2.7	3.8	0.4
2030	Low	3.5	2.8	3.9	0.4
2030	Med	3.1	2.6	3.6	0.3
2040	High	3.3	2.8	4.0	0.4
2040	Low	3.5	3.0	4.1	0.4
2040	Med	3.2	2.7	3.7	0.3

Figure 1-23. Yields for Cotton, AEZ: DS5 | No CO2 fert.

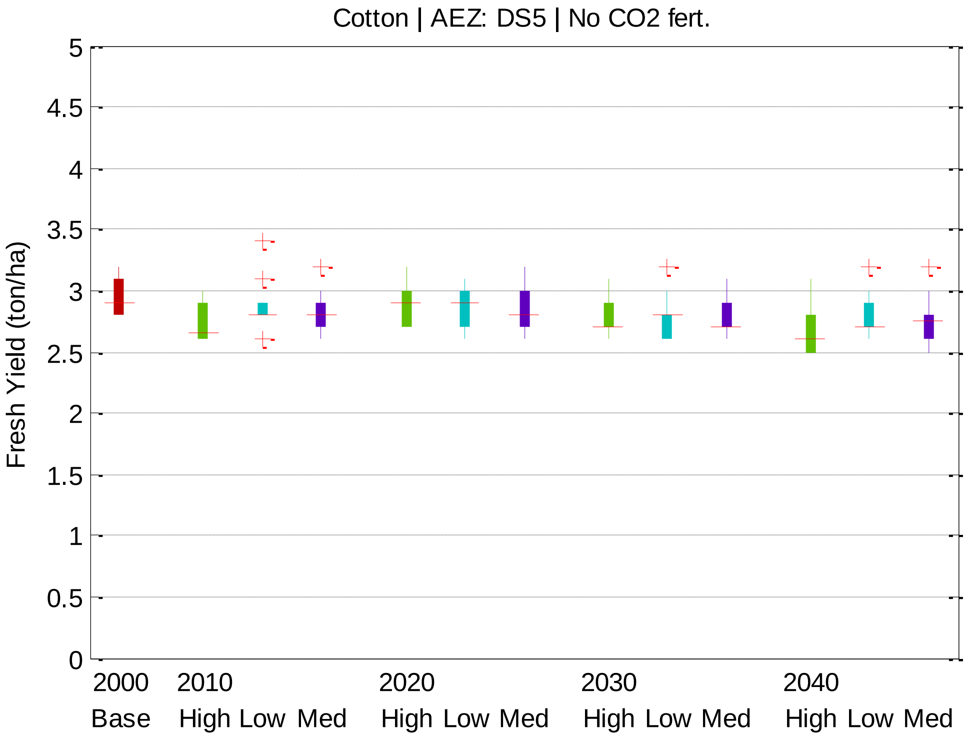

Table 1-23. Yield Statistics for Cotton, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	2.9	2.8	3.2	0.2
2010	High	2.7	2.6	3.0	0.2
2010	Low	2.9	2.6	3.4	0.2
2010	Med	2.8	2.6	3.2	0.2
2020	High	2.9	2.7	3.2	0.2
2020	Low	2.8	2.6	3.1	0.2
2020	Med	2.8	2.6	3.2	0.2
2030	High	2.8	2.6	3.1	0.2
2030	Low	2.8	2.6	3.2	0.2
2030	Med	2.8	2.6	3.1	0.2
2040	High	2.7	2.5	3.1	0.2
2040	Low	2.8	2.6	3.2	0.2
2040	Med	2.8	2.5	3.2	0.2

Figure 1-24. Yields for Cotton, AEZ: DS5 | CO2 fert.

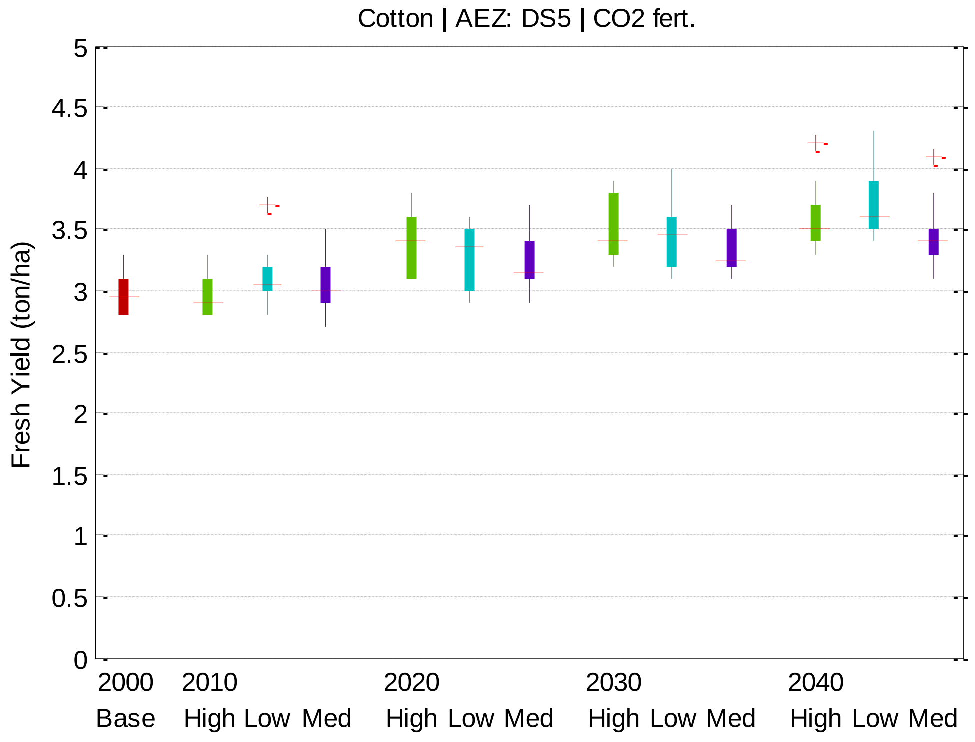

Table 1-24. Yield Statistics for Cotton, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.0	2.8	3.3	0.2
2010	High	3.0	2.8	3.3	0.2
2010	Low	3.1	2.8	3.7	0.3
2010	Med	3.0	2.7	3.5	0.2
2020	High	3.4	3.1	3.8	0.3
2020	Low	3.3	2.9	3.6	0.3
2020	Med	3.2	2.9	3.7	0.2
2030	High	3.5	3.2	3.9	0.3
2030	Low	3.5	3.1	4.0	0.3
2030	Med	3.3	3.1	3.7	0.2
2040	High	3.6	3.3	4.2	0.3
2040	Low	3.7	3.4	4.3	0.3
2040	Med	3.5	3.1	4.1	0.3

Figure 1-25. Yields for Cotton, AEZ: PI1 | No CO2 fert.

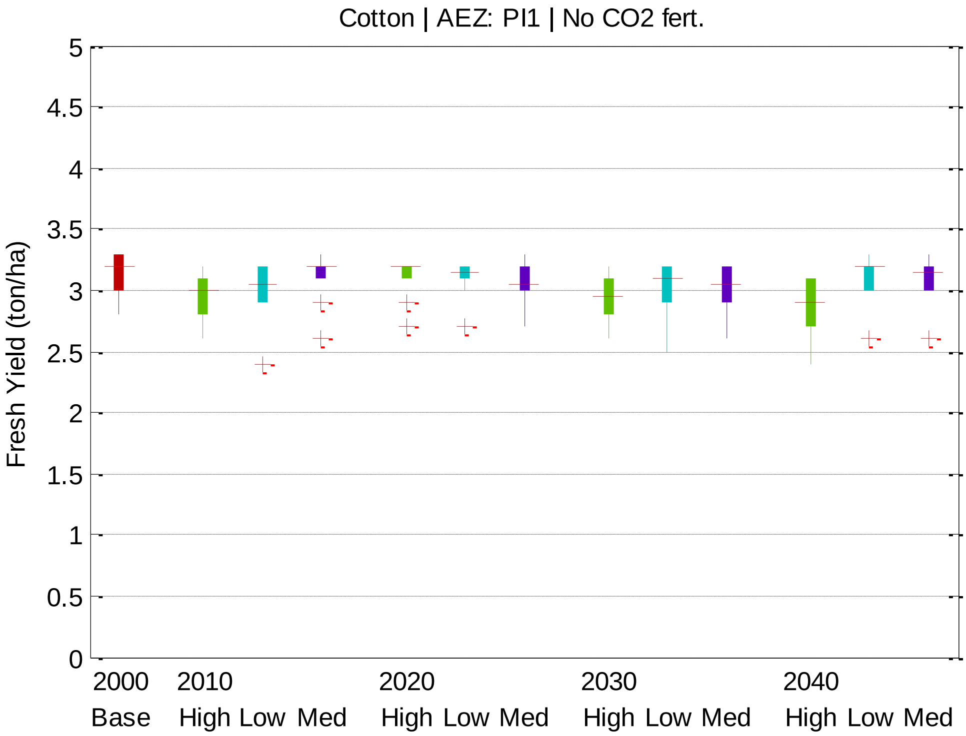

Table 1-25. Yield Statistics for Cotton, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.1	2.8	3.3	0.2
2010	High	3.0	2.6	3.2	0.2
2010	Low	3.0	2.4	3.2	0.2
2010	Med	3.1	2.6	3.3	0.2
2020	High	3.1	2.7	3.2	0.2
2020	Low	3.1	2.7	3.2	0.2
2020	Med	3.1	2.7	3.3	0.2
2030	High	3.0	2.6	3.2	0.2
2030	Low	3.0	2.5	3.2	0.2
2030	Med	3.0	2.6	3.2	0.2
2040	High	2.9	2.4	3.1	0.2
2040	Low	3.1	2.6	3.3	0.2
2040	Med	3.1	2.6	3.3	0.2

Figure 1-26. Yields for Cotton, AEZ: PI1 | CO2 fert.

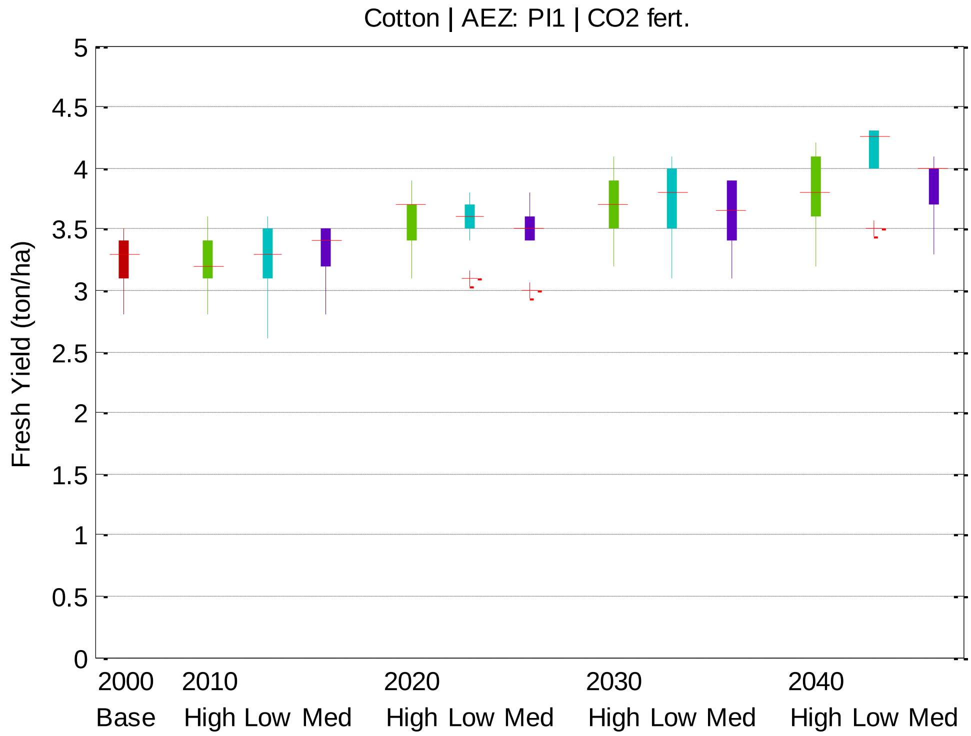

Table 1-26. Yield Statistics for Cotton, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.2	2.8	3.5	0.2
2010	High	3.2	2.8	3.6	0.2
2010	Low	3.2	2.6	3.6	0.3
2010	Med	3.3	2.8	3.5	0.2
2020	High	3.6	3.1	3.9	0.2
2020	Low	3.6	3.1	3.8	0.2
2020	Med	3.5	3.0	3.8	0.2
2030	High	3.7	3.2	4.1	0.3
2030	Low	3.8	3.1	4.1	0.3
2030	Med	3.6	3.1	3.9	0.3
2040	High	3.8	3.2	4.2	0.3
2040	Low	4.1	3.5	4.3	0.3
2040	Med	3.9	3.3	4.1	0.2

Figure 1-27. Yields for Cotton, AEZ: PI3 | No CO2 fert.

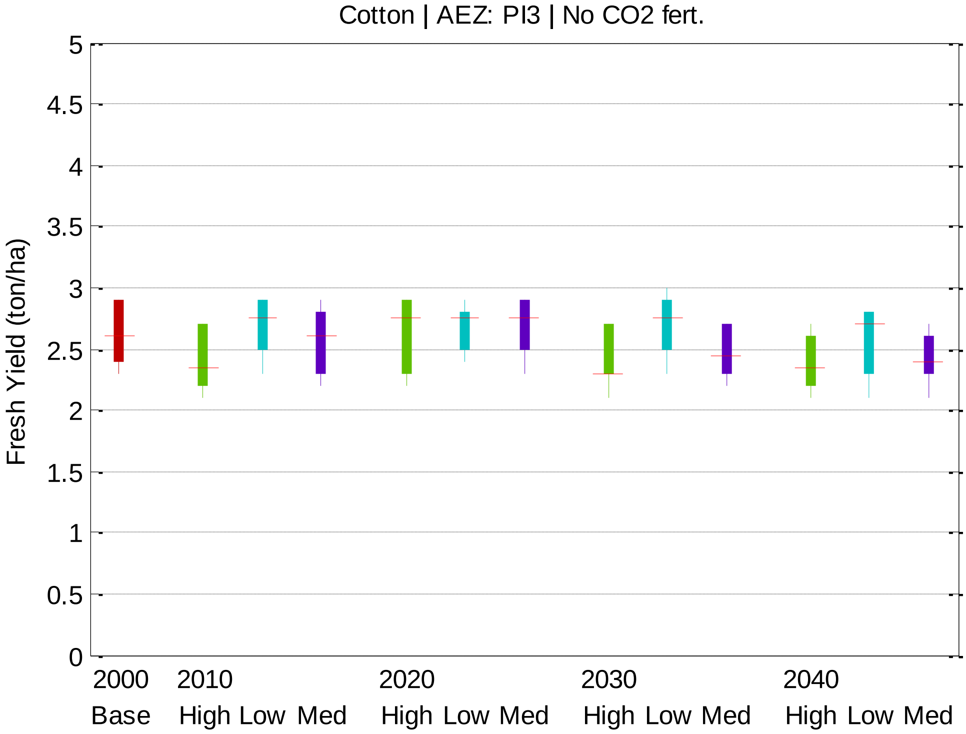

Table 1-27. Yield Statistics for Cotton, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	2.6	2.3	2.9	0.3
2010	High	2.4	2.1	2.7	0.2
2010	Low	2.7	2.3	2.9	0.2
2010	Med	2.5	2.2	2.9	0.3
2020	High	2.6	2.2	2.9	0.3
2020	Low	2.7	2.4	2.9	0.2
2020	Med	2.7	2.3	2.9	0.2
2030	High	2.4	2.1	2.7	0.2
2030	Low	2.7	2.3	3.0	0.2
2030	Med	2.5	2.2	2.7	0.2
2040	High	2.4	2.1	2.7	0.2
2040	Low	2.6	2.1	2.8	0.3
2040	Med	2.4	2.1	2.7	0.2

Figure 1-28. Yields for Cotton, AEZ: PI3 | CO2 fert.

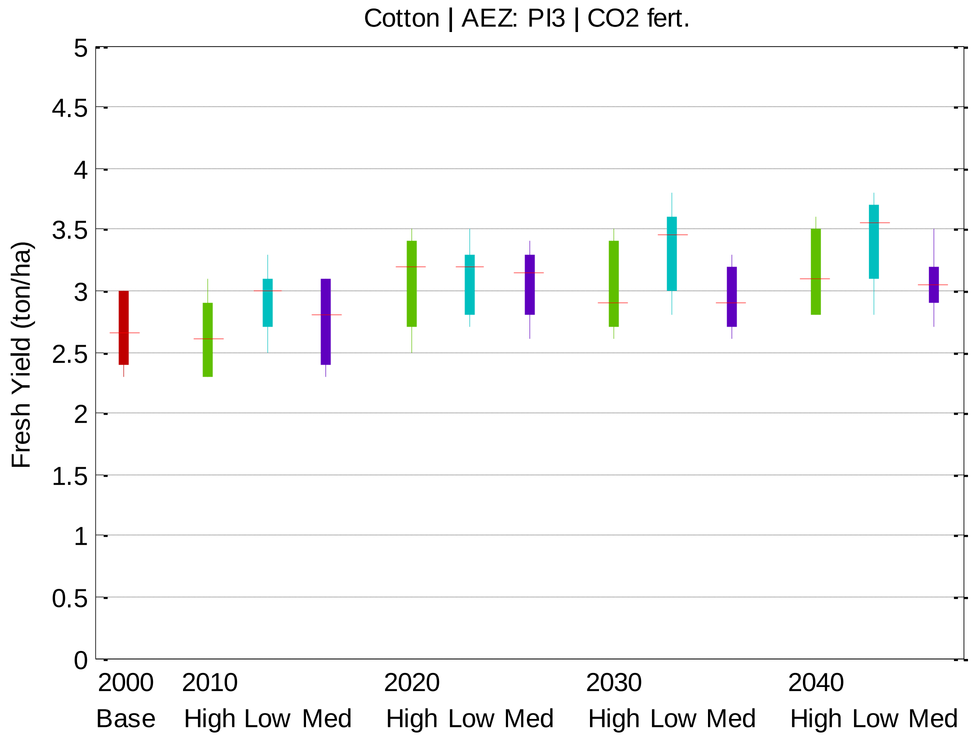

Table 1-28. Yield Statistics for Cotton, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	2.7	2.3	3.0	0.3
2010	High	2.6	2.3	3.1	0.3
2010	Low	2.9	2.5	3.3	0.3
2010	Med	2.8	2.3	3.1	0.3
2020	High	3.1	2.5	3.5	0.4
2020	Low	3.1	2.7	3.5	0.3
2020	Med	3.1	2.6	3.4	0.3
2030	High	3.0	2.6	3.5	0.3
2030	Low	3.3	2.8	3.8	0.4
2030	Med	3.0	2.6	3.3	0.3
2040	High	3.2	2.8	3.6	0.3
2040	Low	3.4	2.8	3.8	0.3
2040	Med	3.1	2.7	3.5	0.3

A.4 **Grassland**

Figure 1-29. Yields for Grassland, AEZ: DS2 | No CO2 fert.

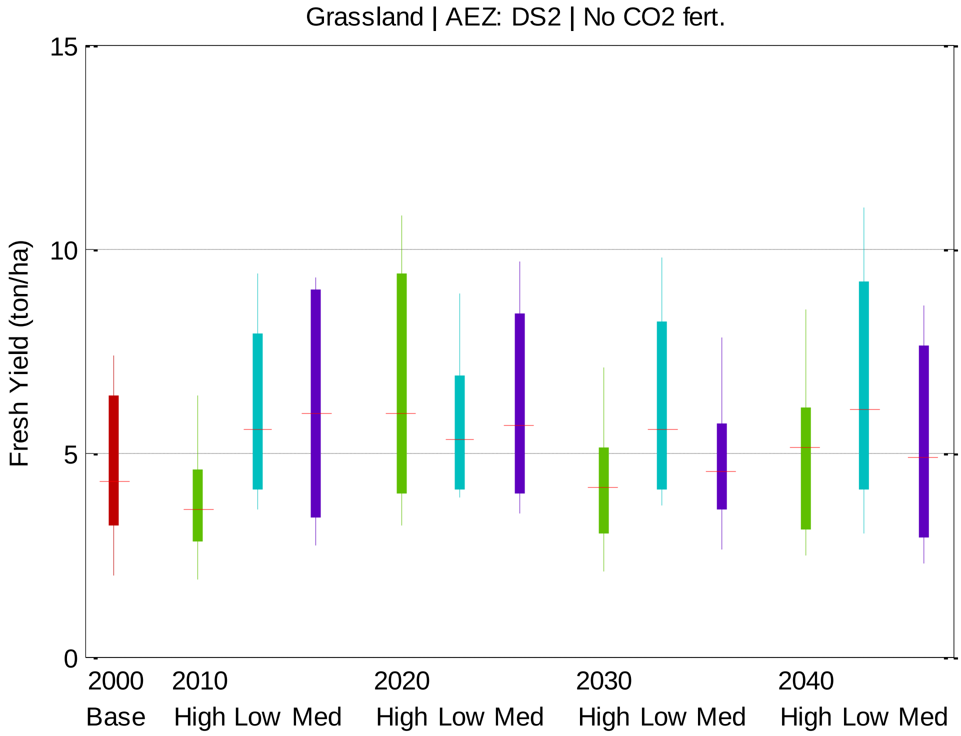

Table 1-29. Yield Statistics for Grassland, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.6	2.0	7.4	1.9
2010	High	3.7	1.9	6.4	1.4
2010	Low	6.0	3.6	9.4	2.1
2010	Med	5.9	2.7	9.3	2.6
2020	High	6.4	3.2	10.8	2.7
2020	Low	5.7	3.9	8.9	1.8
2020	Med	6.0	3.5	9.7	2.3
2030	High	4.1	2.1	7.1	1.5
2030	Low	6.1	3.7	9.8	2.2
2030	Med	4.7	2.6	7.8	1.7
2040	High	5.0	2.5	8.5	1.8
2040	Low	6.5	3.0	11.0	2.7
2040	Med	5.2	2.3	8.6	2.4

Figure 1-30. Yields for Grassland, AEZ: DS2 | CO2 fert.

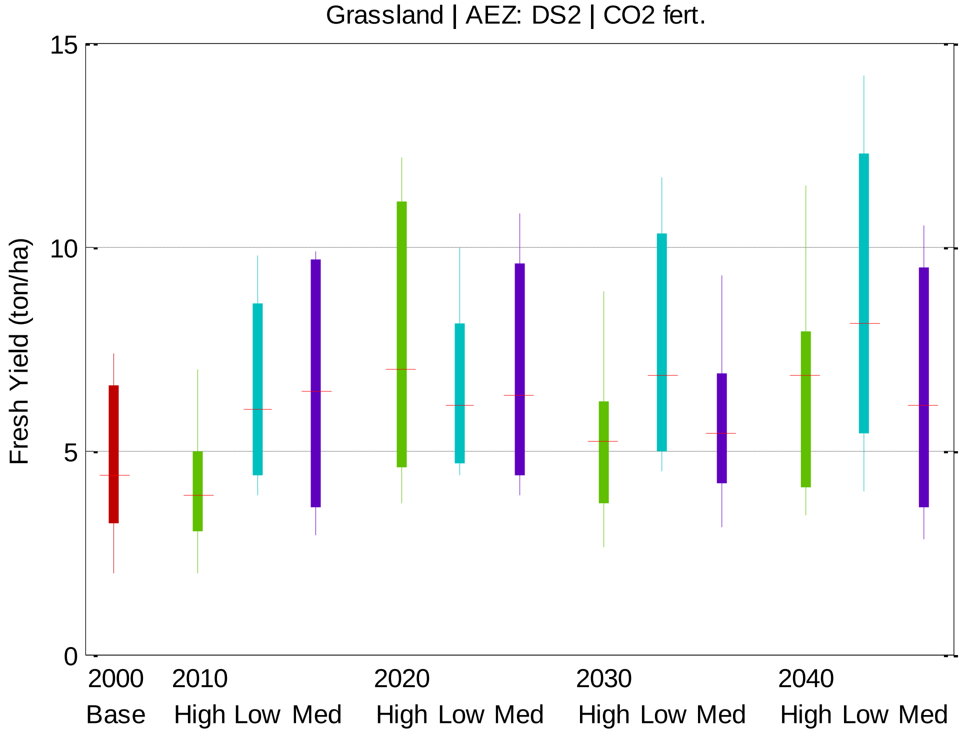

Table 1-30. Yield Statistics for Grassland, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.7	2.0	7.4	1.9
2010	High	4.0	2.0	7.0	1.5
2010	Low	6.4	3.9	9.8	2.2
2010	Med	6.4	2.9	9.9	2.8
2020	High	7.5	3.7	12.2	3.1
2020	Low	6.6	4.4	10.0	2.1
2020	Med	6.8	3.9	10.8	2.6
2030	High	5.2	2.6	8.9	1.9
2030	Low	7.5	4.5	11.7	2.7
2030	Med	5.6	3.1	9.3	2.0
2040	High	6.7	3.4	11.5	2.4
2040	Low	8.7	4.0	14.2	3.6
2040	Med	6.5	2.8	10.5	3.0

Figure 1-31. Yields for Grassland, AEZ: DS5 | No CO2 fert.

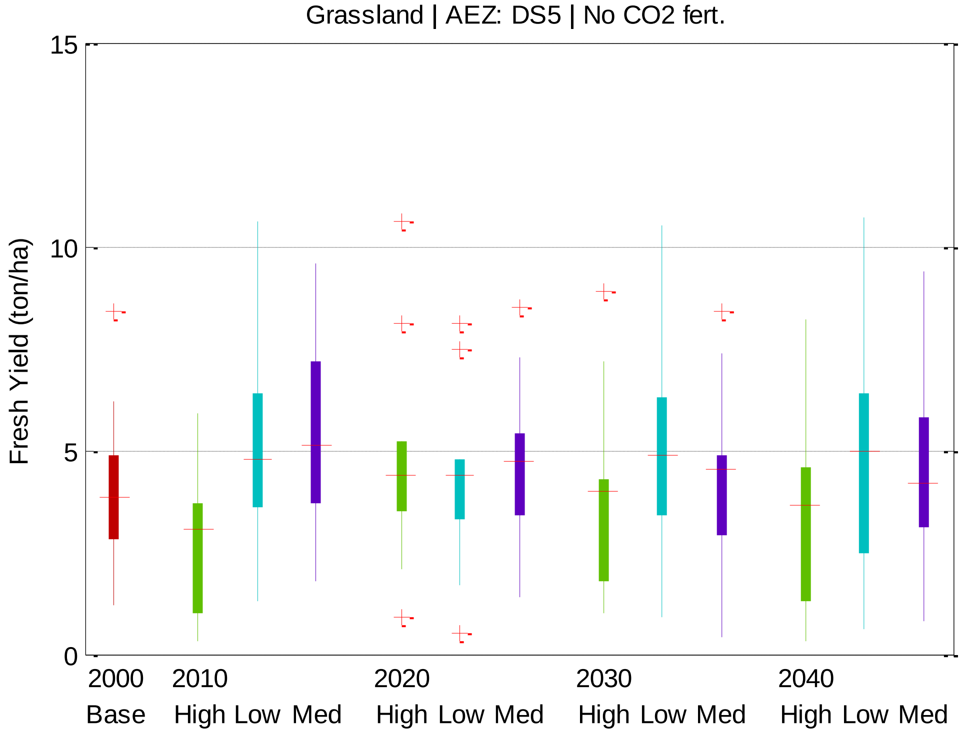

Table 1-31. Yield Statistics for Grassland, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.0	1.2	8.4	2.1
2010	High	2.8	0.3	5.9	1.9
2010	Low	5.2	1.3	10.6	2.8
2010	Med	5.3	1.8	9.6	2.5
2020	High	4.8	0.9	10.6	2.8
2020	Low	4.3	0.5	8.1	2.3
2020	Med	4.7	1.4	8.5	2.1
2030	High	4.0	1.0	8.9	2.5
2030	Low	5.1	0.9	10.5	2.9
2030	Med	4.2	0.4	8.4	2.5
2040	High	3.7	0.3	8.2	2.7
2040	Low	5.1	0.6	10.7	3.1
2040	Med	4.6	0.8	9.4	2.5

Figure 1-32. Yields for Grassland, AEZ: DS5 | CO2 fert.

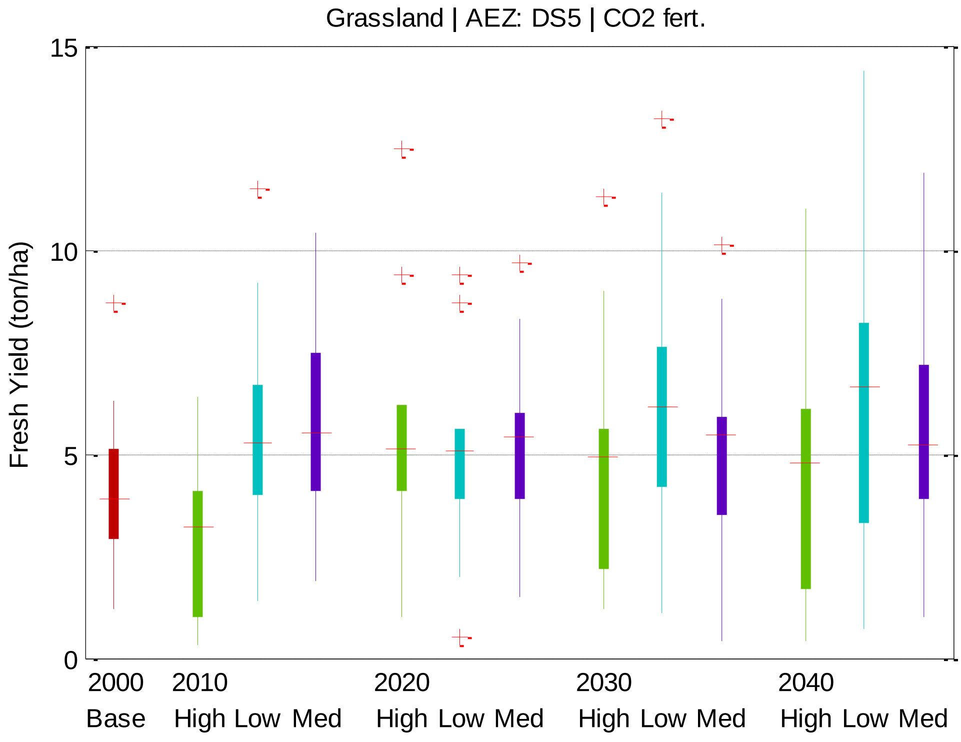

Table 1-32. Yield Statistics for Grassland, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.2	1.2	8.7	2.2
2010	High	3.1	0.3	6.4	2.1
2010	Low	5.6	1.4	11.5	3.0
2010	Med	5.7	1.9	10.4	2.7
2020	High	5.6	1.0	12.5	3.3
2020	Low	5.0	0.5	9.4	2.7
2020	Med	5.3	1.5	9.7	2.4
2030	High	5.0	1.2	11.3	3.2
2030	Low	6.4	1.1	13.2	3.7
2030	Med	5.1	0.4	10.1	2.9
2040	High	4.9	0.4	11.0	3.6
2040	Low	6.8	0.7	14.4	4.2
2040	Med	5.8	1.0	11.9	3.2

Figure 1-33. Yields for Grassland, AEZ: HI3 | No CO2 fert.

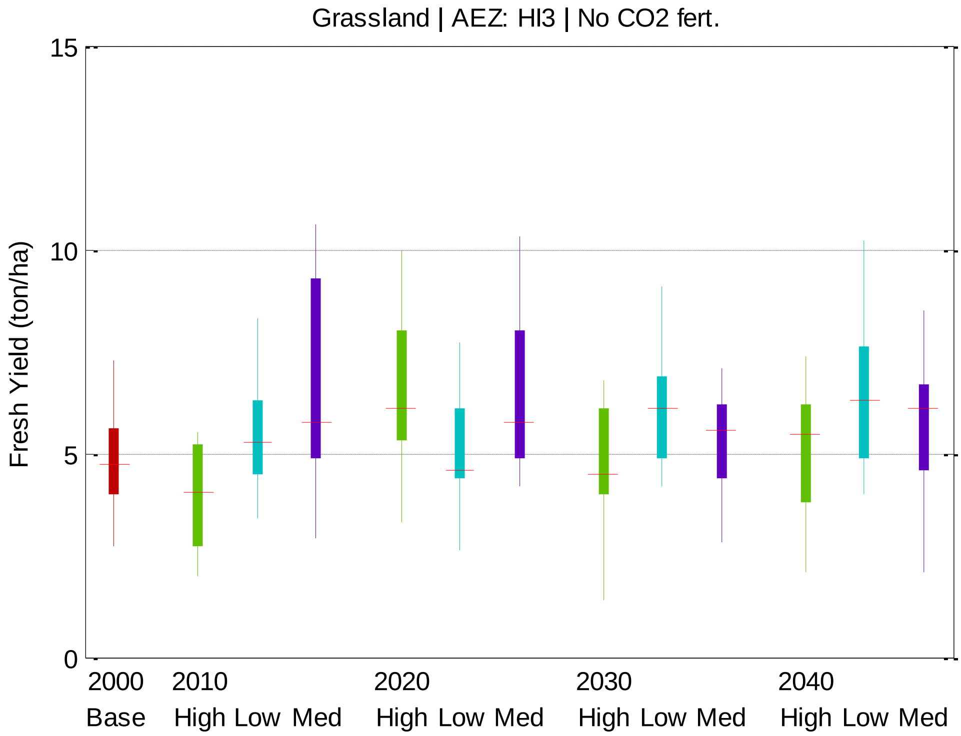

Table 1-33. Yield Statistics for Grassland, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.9	2.7	7.3	1.4
2010	High	3.9	2.0	5.5	1.3
2010	Low	5.4	3.4	8.3	1.4
2010	Med	6.6	2.9	10.6	2.7
2020	High	6.5	3.3	10.0	2.0
2020	Low	5.0	2.6	7.7	1.4
2020	Med	6.4	4.2	10.3	2.0
2030	High	4.6	1.4	6.8	1.7
2030	Low	6.1	4.2	9.1	1.6
2030	Med	5.2	2.8	7.1	1.5
2040	High	5.0	2.1	7.4	1.7
2040	Low	6.4	4.0	10.2	1.9
2040	Med	5.4	2.1	8.5	2.0

Figure 1-34. Yields for Grassland, AEZ: HI3 | CO2 fert.

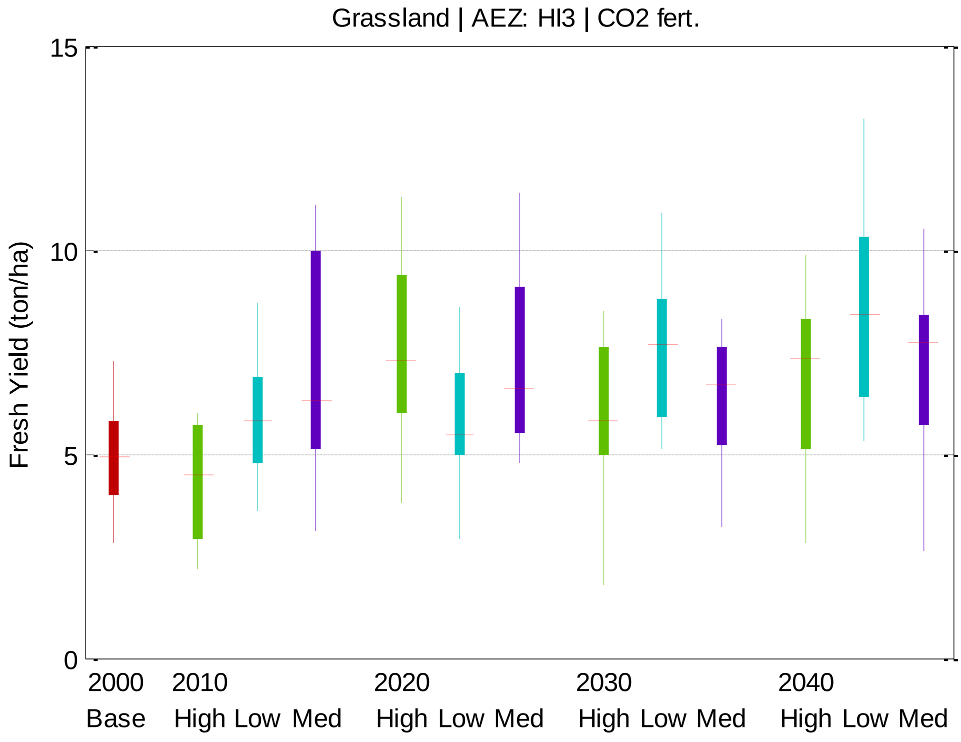

Table 1-34. Yield Statistics for Grassland, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	5.0	2.8	7.3	1.4
2010	High	4.2	2.2	6.0	1.4
2010	Low	5.8	3.6	8.7	1.5
2010	Med	7.1	3.1	11.1	2.8
2020	High	7.5	3.8	11.3	2.4
2020	Low	5.8	2.9	8.6	1.6
2020	Med	7.3	4.8	11.4	2.3
2030	High	5.8	1.8	8.5	2.1
2030	Low	7.6	5.1	10.9	2.0
2030	Med	6.2	3.2	8.3	1.8
2040	High	6.7	2.8	9.9	2.3
2040	Low	8.5	5.3	13.2	2.5
2040	Med	6.8	2.6	10.5	2.5

Figure 1-35. Yields for Grassland, AEZ: PI1 | No CO2 fert.

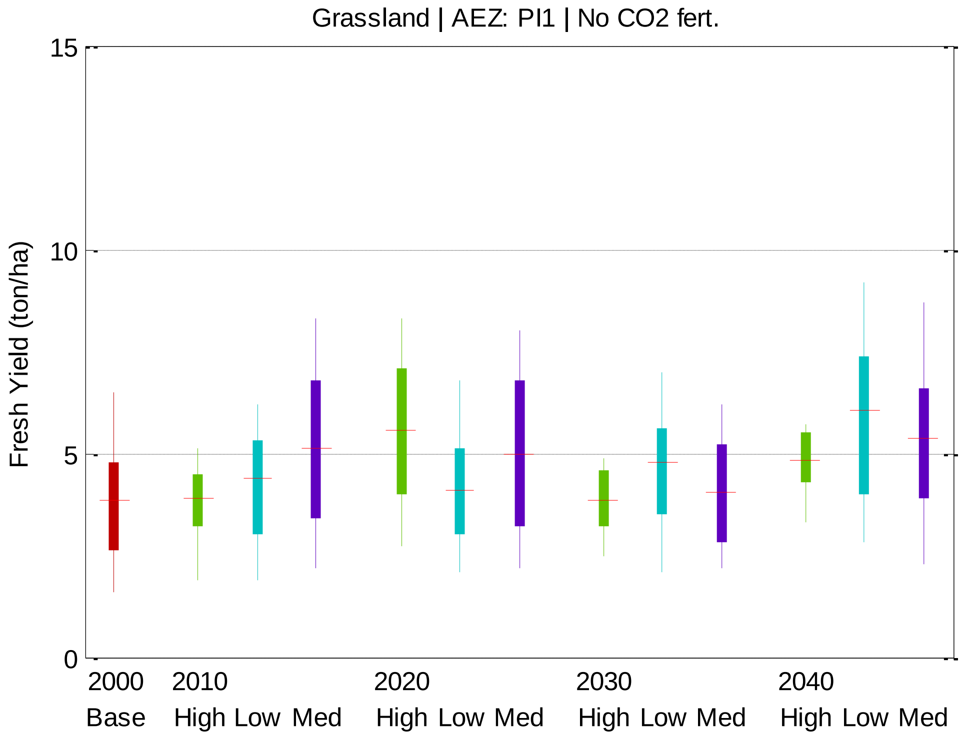

Table 1-35. Yield Statistics for Grassland, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.7	1.6	6.5	1.5
2010	High	3.7	1.9	5.1	1.0
2010	Low	4.1	1.9	6.2	1.4
2010	Med	5.1	2.2	8.3	2.1
2020	High	5.5	2.7	8.3	1.9
2020	Low	4.1	2.1	6.8	1.4
2020	Med	4.9	2.2	8.0	1.9
2030	High	3.8	2.5	4.9	0.8
2030	Low	4.6	2.1	7.0	1.5
2030	Med	4.0	2.2	6.2	1.3
2040	High	4.8	3.3	5.7	0.8
2040	Low	5.8	2.8	9.2	2.1
2040	Med	5.3	2.3	8.7	2.0

Figure 1-36. Yields for Grassland, AEZ: PI1 | CO2 fert.

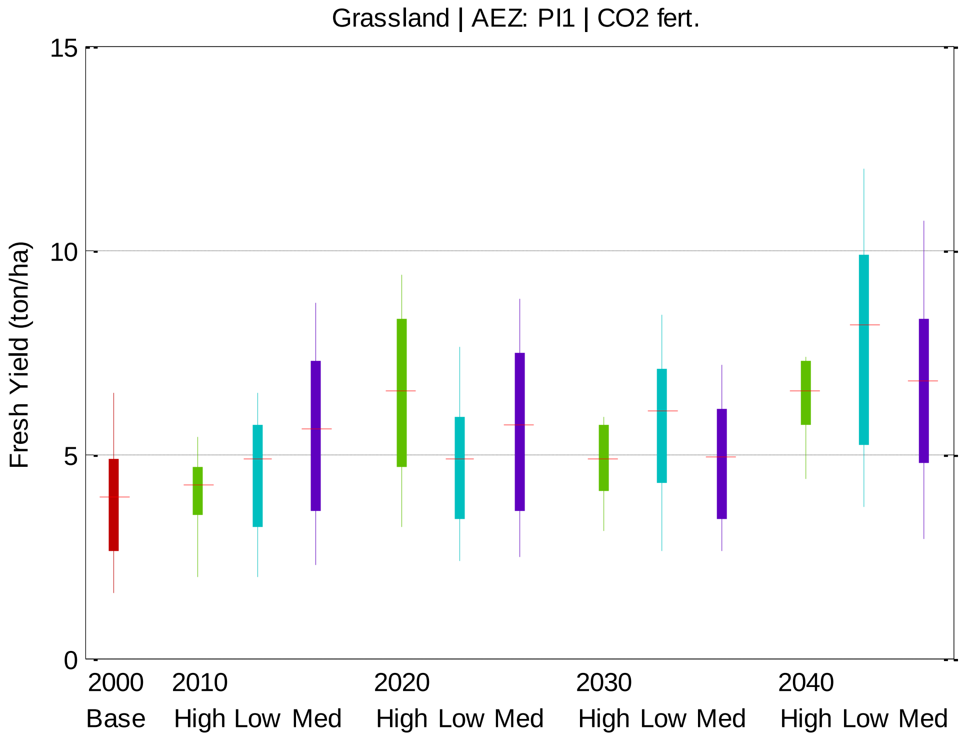

Table 1-36. Yield Statistics for Grassland, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.8	1.6	6.5	1.5
2010	High	4.0	2.0	5.4	1.0
2010	Low	4.4	2.0	6.5	1.5
2010	Med	5.5	2.3	8.7	2.2
2020	High	6.4	3.2	9.4	2.1
2020	Low	4.7	2.4	7.6	1.5
2020	Med	5.6	2.5	8.8	2.1
2030	High	4.7	3.1	5.9	1.0
2030	Low	5.7	2.6	8.4	1.8
2030	Med	4.8	2.6	7.2	1.5
2040	High	6.3	4.4	7.4	1.0
2040	Low	7.7	3.7	12.0	2.8
2040	Med	6.6	2.9	10.7	2.5

Figure 1-37. Yields for Grassland, AEZ: PI3 | No CO2 fert.

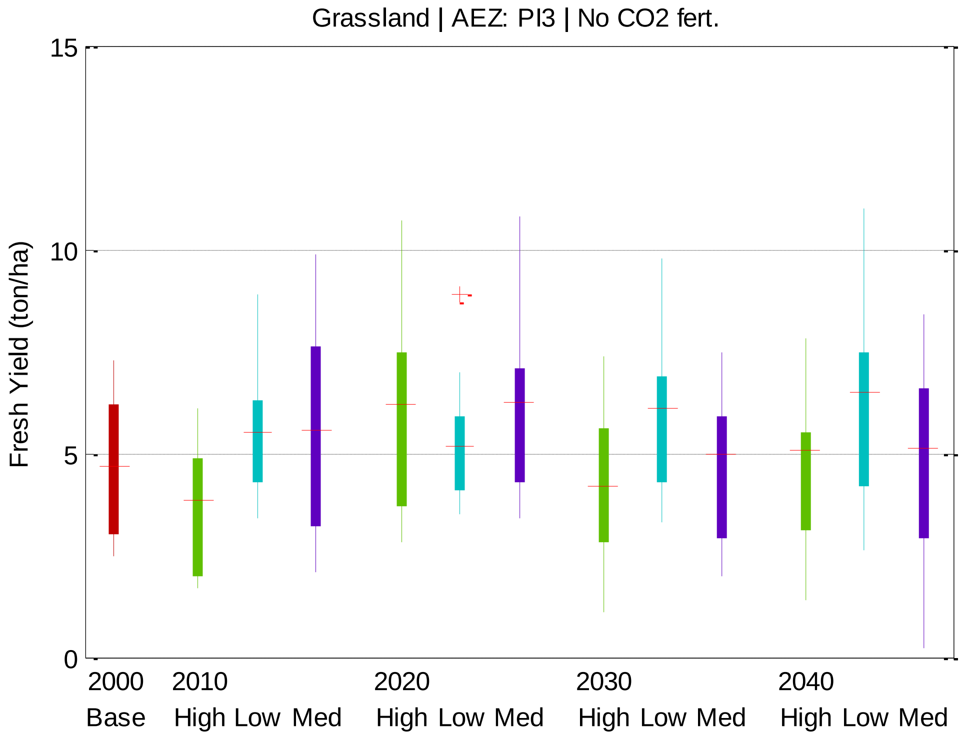

Table 1-37. Yield Statistics for Grassland, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.8	2.5	7.3	1.6
2010	High	3.7	1.7	6.1	1.5
2010	Low	5.6	3.4	8.9	1.6
2010	Med	5.7	2.1	9.9	2.7
2020	High	6.1	2.8	10.7	2.4
2020	Low	5.4	3.5	8.9	1.6
2020	Med	6.2	3.4	10.8	2.2
2030	High	4.3	1.1	7.4	1.9
2030	Low	6.0	3.3	9.8	1.9
2030	Med	4.8	2.0	7.5	1.9
2040	High	4.5	1.4	7.8	2.0
2040	Low	6.3	2.6	11.0	2.4
2040	Med	4.7	0.2	8.4	2.4

Figure 1-38. Yields for Grassland, AEZ: PI3 | CO2 fert.

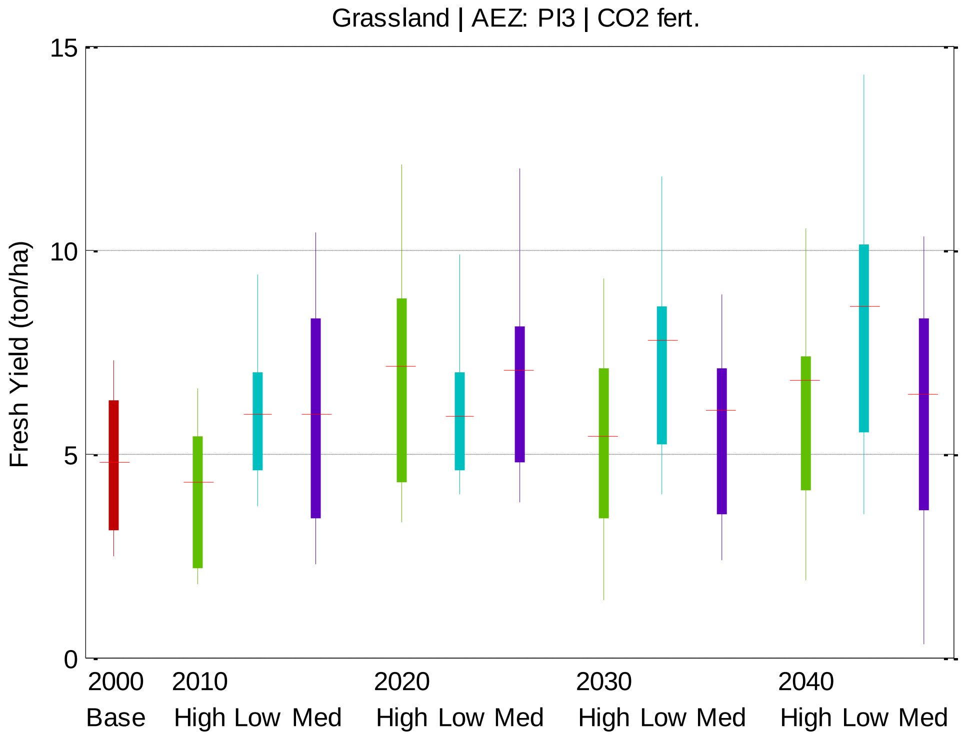

Table 1-38. Yield Statistics for Grassland, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.9	2.5	7.3	1.7
2010	High	4.1	1.8	6.6	1.7
2010	Low	6.1	3.7	9.4	1.7
2010	Med	6.2	2.3	10.4	2.9
2020	High	7.1	3.3	12.1	2.8
2020	Low	6.2	4.0	9.9	1.8
2020	Med	7.0	3.8	12.0	2.5
2030	High	5.4	1.4	9.3	2.4
2030	Low	7.5	4.0	11.8	2.3
2030	Med	5.7	2.4	8.9	2.3
2040	High	6.0	1.9	10.5	2.7
2040	Low	8.4	3.5	14.3	3.1
2040	Med	5.9	0.3	10.3	3.0

A.5 Potatoes

Figure 1-39. Yields for Potatoes, AEZ: DS2 | No CO2 fert.

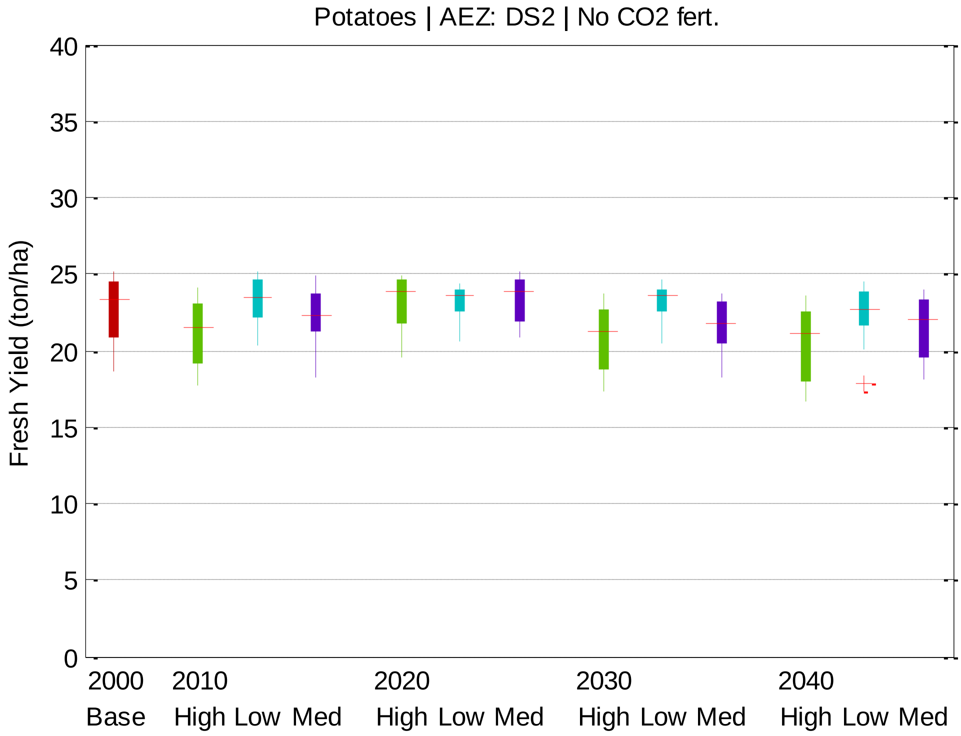

Table 1-39. Yield Statistics for Potatoes, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	22.7	18.6	25.1	2.2
2010	High	21.1	17.7	24.1	2.3
2010	Low	23.1	20.3	25.2	1.7
2010	Med	22.1	18.3	24.9	2.3
2020	High	23.1	19.6	24.9	1.8
2020	Low	23.1	20.6	24.4	1.2
2020	Med	23.3	20.8	25.1	1.7
2030	High	20.6	17.3	23.7	2.4
2030	Low	23.1	20.5	24.6	1.3
2030	Med	21.5	18.2	23.7	2.0
2040	High	20.5	16.7	23.6	2.4
2040	Low	22.3	17.8	24.5	2.1
2040	Med	21.4	18.1	24.0	2.3

Figure 1-40. Yields for Potatoes, AEZ: DS2 | CO2 fert.

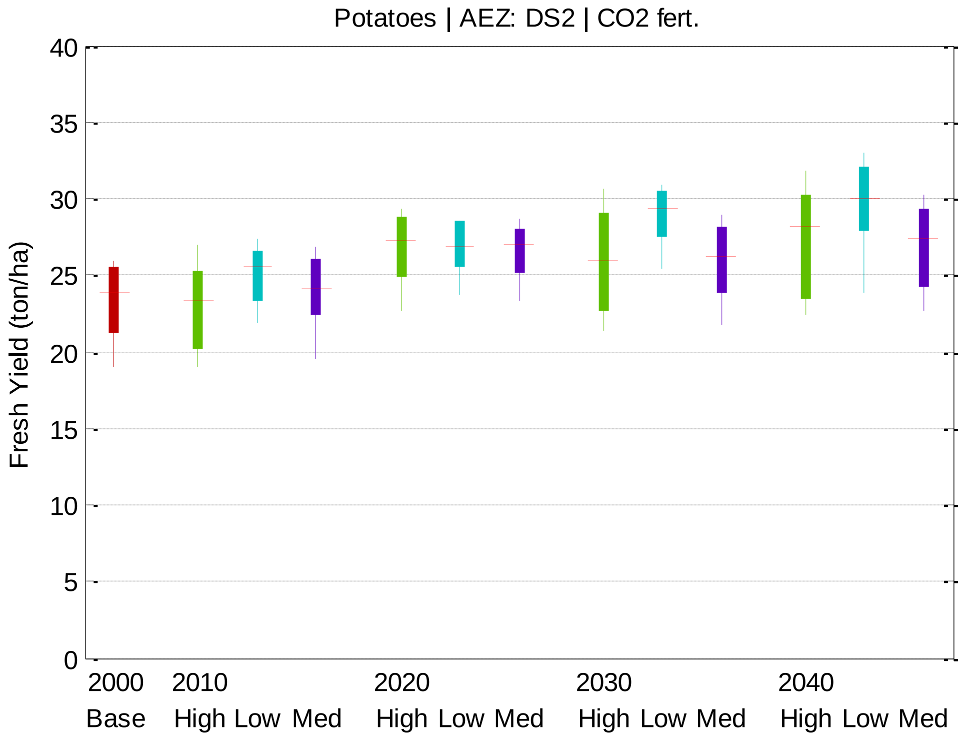

Table 1-40. Yield Statistics for Potatoes, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	23.3	19.0	25.9	2.5
2010	High	23.0	19.0	27.0	2.8
2010	Low	25.0	21.9	27.4	2.0
2010	Med	23.8	19.6	26.9	2.6
2020	High	26.8	22.7	29.3	2.4
2020	Low	26.7	23.7	28.6	1.7
2020	Med	26.4	23.3	28.7	2.0
2030	High	25.8	21.4	30.6	3.4
2030	Low	28.7	25.4	30.9	1.9
2030	Med	25.7	21.7	29.0	2.6
2040	High	27.3	22.4	31.8	3.4
2040	Low	29.6	23.8	33.0	2.9
2040	Med	26.8	22.7	30.3	3.0

Figure 1-41. Yields for Potatoes, AEZ: DS5 | No CO2 fert.

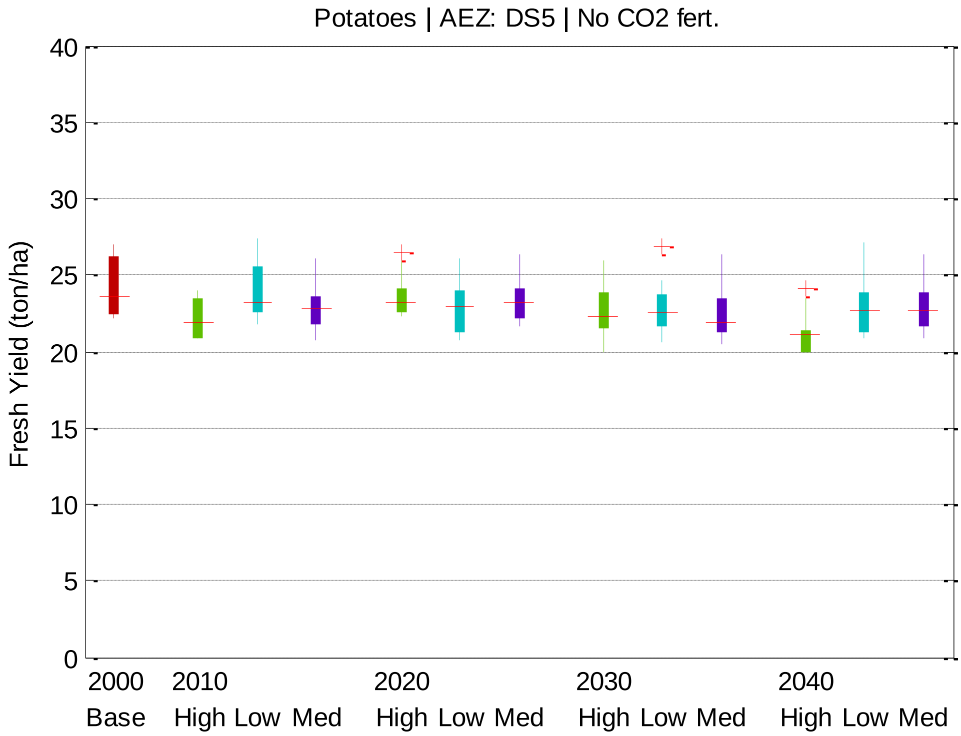

Table 1-41. Yield Statistics for Potatoes, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	24.0	22.2	27.0	1.8
2010	High	22.1	20.8	24.0	1.2
2010	Low	23.9	21.8	27.4	1.9
2010	Med	23.0	20.7	26.1	1.7
2020	High	23.8	22.3	26.5	1.5
2020	Low	23.0	20.7	26.1	1.9
2020	Med	23.5	21.6	26.3	1.7
2030	High	22.7	19.9	26.0	1.9
2030	Low	22.8	20.6	26.9	1.9
2030	Med	22.4	20.5	26.3	1.8
2040	High	21.3	19.9	24.1	1.4
2040	Low	22.8	20.8	27.1	2.0
2040	Med	23.0	20.9	26.3	1.6

Figure 1-42. Yields for Potatoes, AEZ: DS5 | CO2 fert.

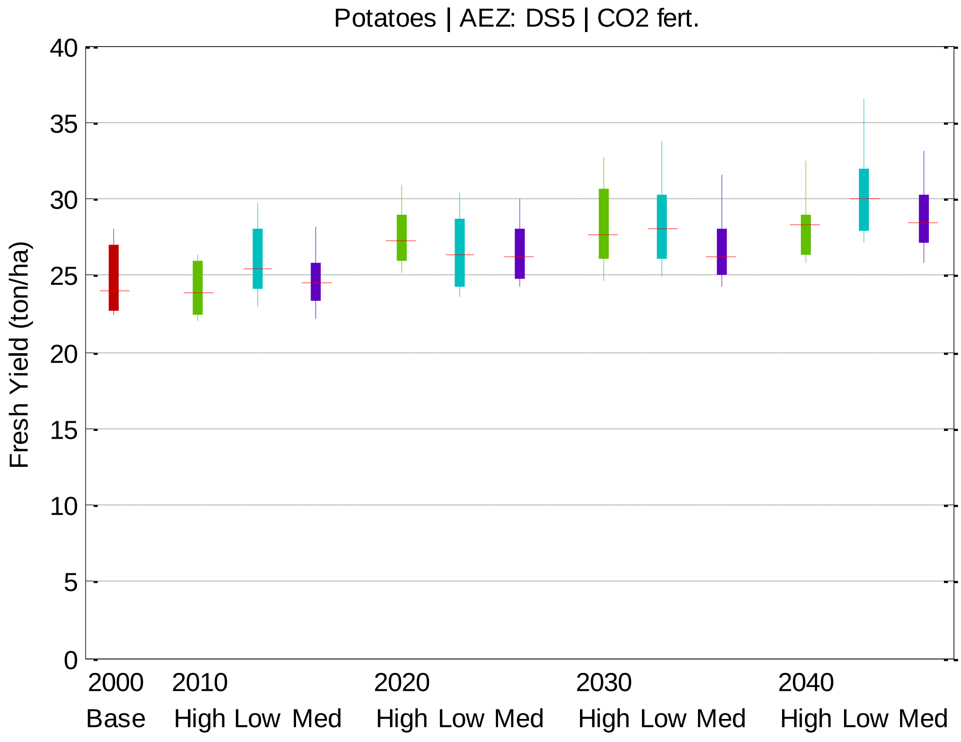

Table 1-42. Yield Statistics for Potatoes, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	24.6	22.4	28.0	2.1
2010	High	24.0	22.0	26.4	1.7
2010	Low	25.8	22.9	29.8	2.4
2010	Med	24.8	22.1	28.2	2.1
2020	High	27.7	25.1	30.9	2.1
2020	Low	26.6	23.6	30.4	2.6
2020	Med	26.6	24.3	30.0	2.1
2030	High	28.4	24.6	32.8	2.8
2030	Low	28.4	24.9	33.8	2.8
2030	Med	26.7	24.3	31.6	2.3
2040	High	28.4	25.8	32.5	2.2
2040	Low	30.4	27.1	36.5	3.0
2040	Med	28.8	25.8	33.1	2.2

Figure 1-43. Yields for Potatoes, AEZ: HI3 | No CO2 fert.

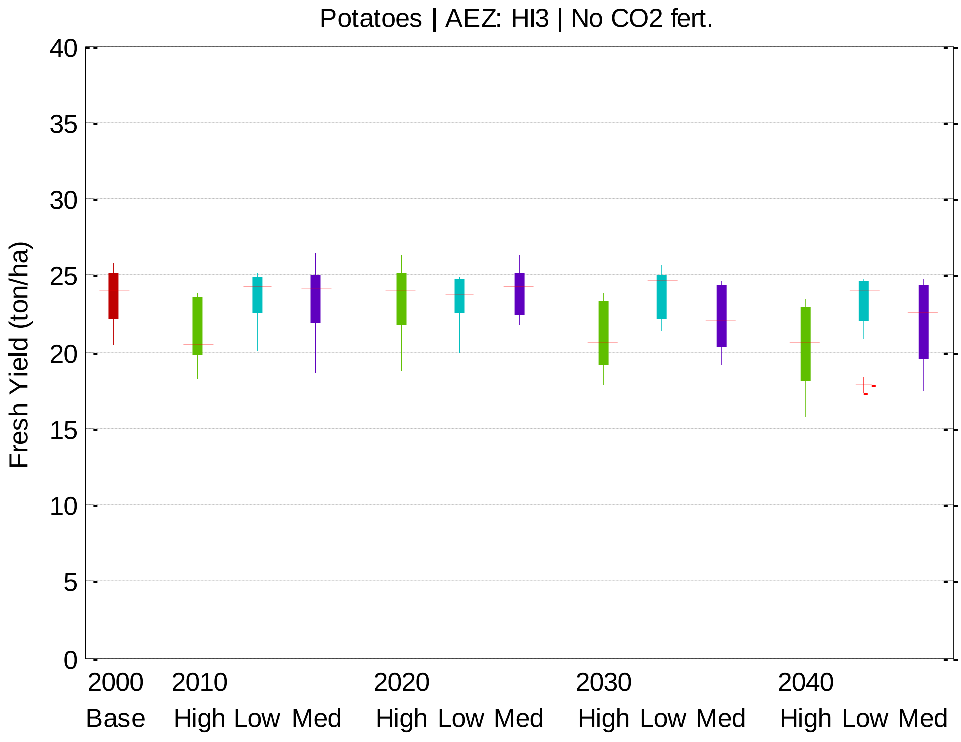

Table 1-43. Yield Statistics for Potatoes, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	23.6	20.4	25.8	1.8
2010	High	21.2	18.3	23.9	2.2
2010	Low	23.6	20.1	25.1	1.6
2010	Med	23.4	18.6	26.5	2.5
2020	High	23.4	18.7	26.3	2.4
2020	Low	23.3	19.9	24.9	1.6
2020	Med	24.1	21.7	26.4	1.6
2030	High	21.1	17.8	23.9	2.3
2030	Low	23.9	21.4	25.7	1.6
2030	Med	22.2	19.1	24.6	2.1
2040	High	20.5	15.8	23.5	2.8
2040	Low	23.0	17.9	24.8	2.2
2040	Med	21.9	17.4	24.8	2.7

Figure 1-44. Yields for Potatoes, AEZ: HI3 | CO2 fert.

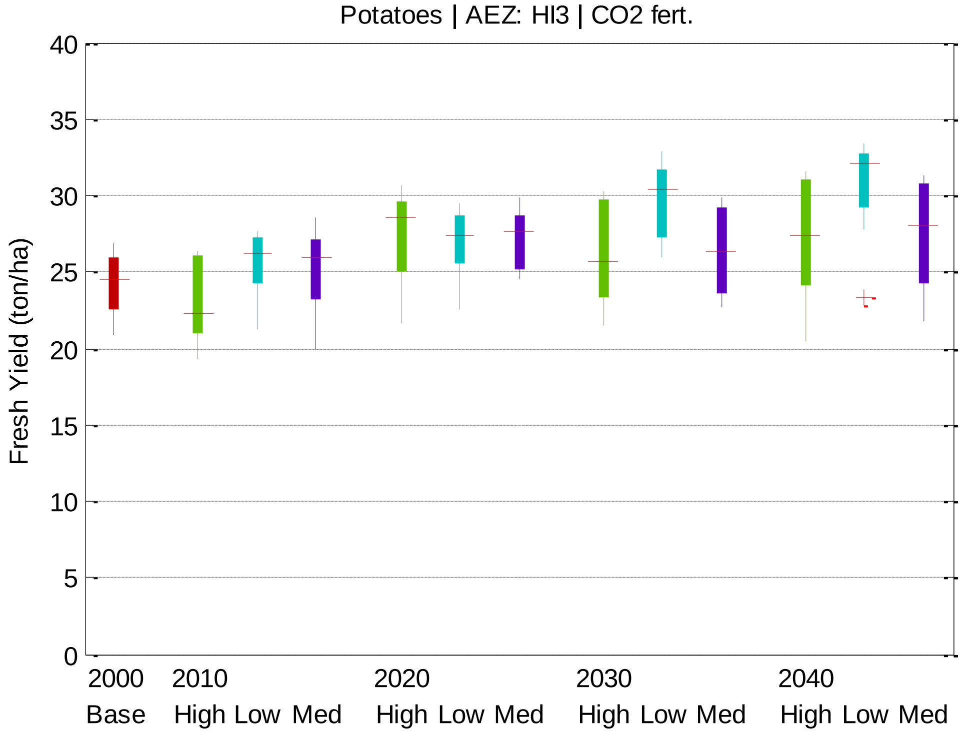

Table 1-44. Yield Statistics for Potatoes, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	24.2	20.9	26.9	2.1
2010	High	23.0	19.3	26.3	2.8
2010	Low	25.5	21.3	27.7	2.1
2010	Med	25.1	19.9	28.5	2.8
2020	High	27.3	21.6	30.7	3.1
2020	Low	27.0	22.5	29.5	2.2
2020	Med	27.3	24.5	29.9	2.0
2030	High	26.3	21.5	30.2	3.3
2030	Low	29.7	25.9	32.9	2.5
2030	Med	26.5	22.7	29.9	2.9
2040	High	27.3	20.5	31.6	4.0
2040	Low	30.6	23.3	33.4	3.2
2040	Med	27.5	21.7	31.3	3.5

Figure 1-45. Yields for Potatoes, AEZ: PI1 | No CO2 fert.

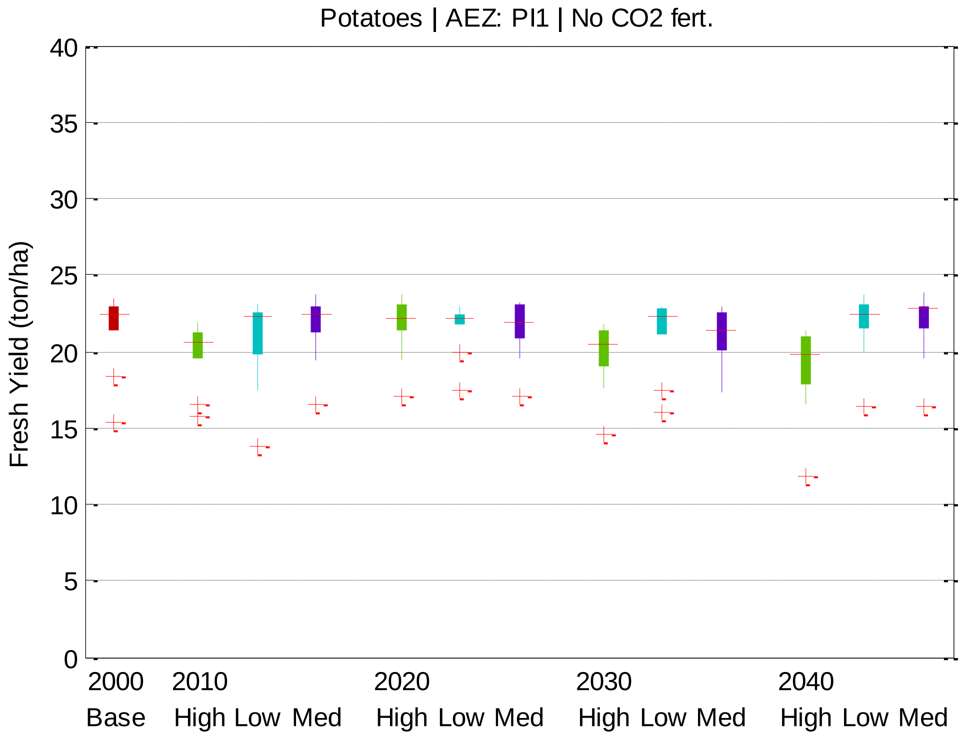

Table 1-45. Yield Statistics for Potatoes, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	21.4	15.4	23.5	2.6
2010	High	19.9	15.8	21.9	2.1
2010	Low	20.8	13.8	23.1	3.0
2010	Med	21.6	16.6	23.7	2.1
2020	High	21.7	17.1	23.7	2.0
2020	Low	21.6	17.5	22.9	1.6
2020	Med	21.4	17.0	23.2	2.0
2030	High	19.8	14.6	21.7	2.2
2030	Low	21.2	16.0	23.0	2.5
2030	Med	21.0	17.3	23.0	1.9
2040	High	18.9	11.8	21.4	2.9
2040	Low	21.8	16.4	23.7	2.2
2040	Med	21.8	16.4	23.8	2.2

Figure 1-46. Yields for Potatoes, AEZ: PI1 | CO2 fert.

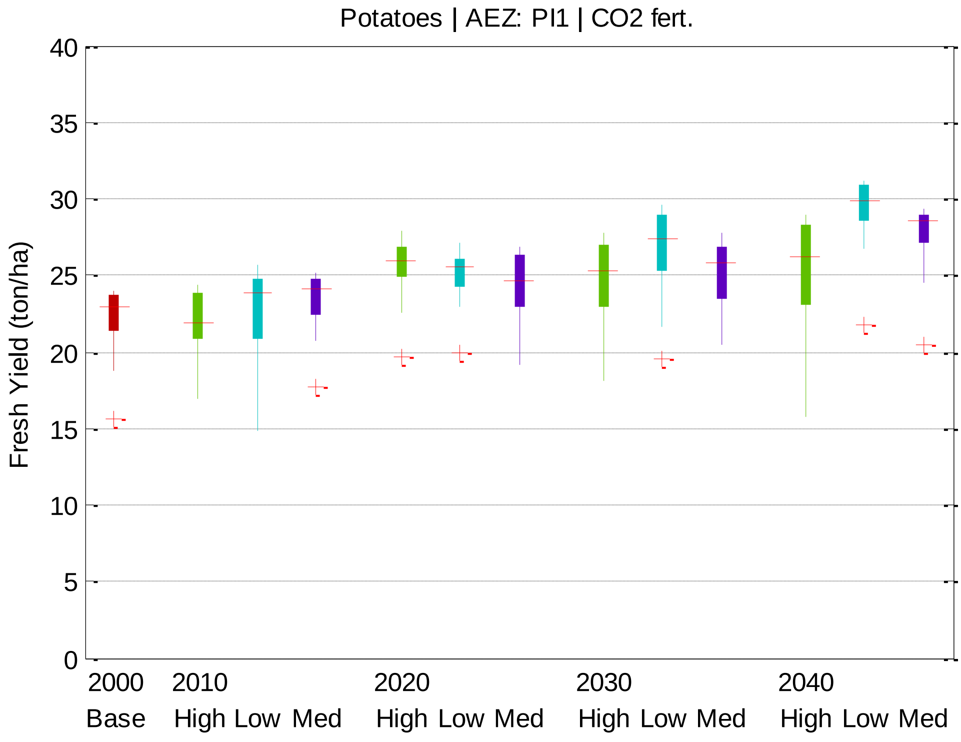

Table 1-46. Yield Statistics for Potatoes, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	21.9	15.6	24.0	2.7
2010	High	21.6	16.9	24.4	2.5
2010	Low	22.5	14.8	25.7	3.4
2010	Med	23.2	17.7	25.2	2.4
2020	High	25.2	19.7	27.9	2.4
2020	Low	24.9	20.0	27.1	2.1
2020	Med	24.3	19.1	26.8	2.4
2030	High	24.7	18.1	27.8	3.0
2030	Low	26.4	19.6	29.6	3.3
2030	Med	25.2	20.5	27.8	2.4
2040	High	25.1	15.7	28.9	4.0
2040	Low	28.9	21.7	31.2	2.9
2040	Med	27.3	20.4	29.4	2.8

Figure 1-47. Yields for Potatoes, AEZ: PI3 | No CO2 fert.

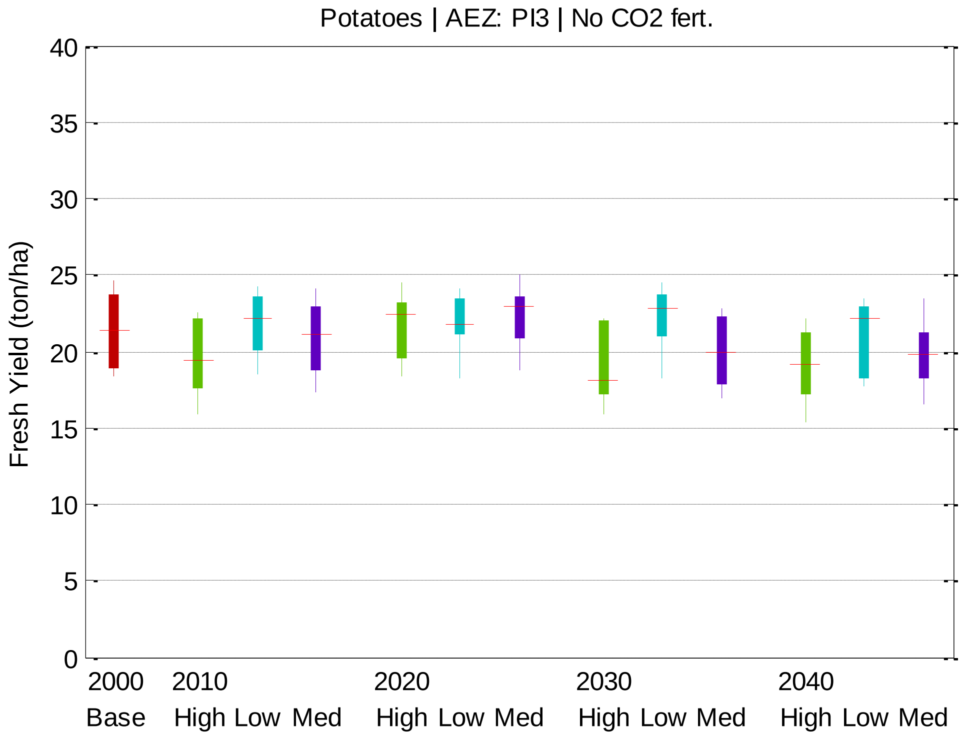

Table 1-47. Yield Statistics for Potatoes, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	21.4	18.4	24.7	2.5
2010	High	19.5	15.9	22.5	2.3
2010	Low	21.9	18.5	24.3	2.0
2010	Med	21.0	17.3	24.1	2.4
2020	High	21.6	18.4	24.5	2.3
2020	Low	21.9	18.2	24.1	1.8
2020	Med	22.4	18.7	25.0	1.9
2030	High	19.0	15.9	22.2	2.5
2030	Low	22.2	18.2	24.5	2.0
2030	Med	20.1	16.9	22.8	2.3
2040	High	19.1	15.4	22.2	2.4
2040	Low	21.1	17.7	23.5	2.4
2040	Med	19.9	16.5	23.4	2.3

Figure 1-48. Yields for Potatoes, AEZ: PI3 | CO2 fert.

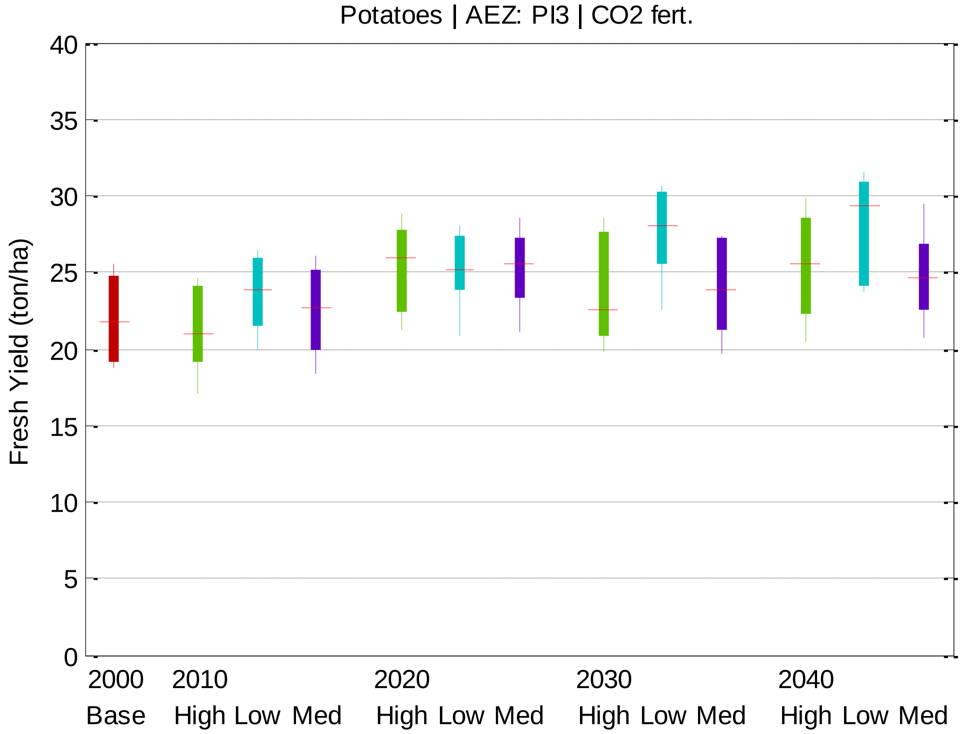

Table 1-48. Yield Statistics for Potatoes, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	22.0	18.8	25.5	2.8
2010	High	21.2	17.0	24.7	2.8
2010	Low	23.7	19.9	26.5	2.5
2010	Med	22.6	18.4	26.1	2.8
2020	High	25.2	21.2	28.8	3.0
2020	Low	25.3	20.9	28.1	2.4
2020	Med	25.4	21.1	28.5	2.4
2030	High	23.7	19.8	28.6	3.4
2030	Low	27.6	22.6	30.7	2.8
2030	Med	24.0	19.7	27.4	3.1
2040	High	25.5	20.5	29.9	3.4
2040	Low	28.1	23.7	31.6	3.4
2040	Med	25.0	20.7	29.5	3.0

A.6 **Tomatoes**

Figure 1-49. Yields for Tomatoes, AEZ: DS2 | No CO2 fert.

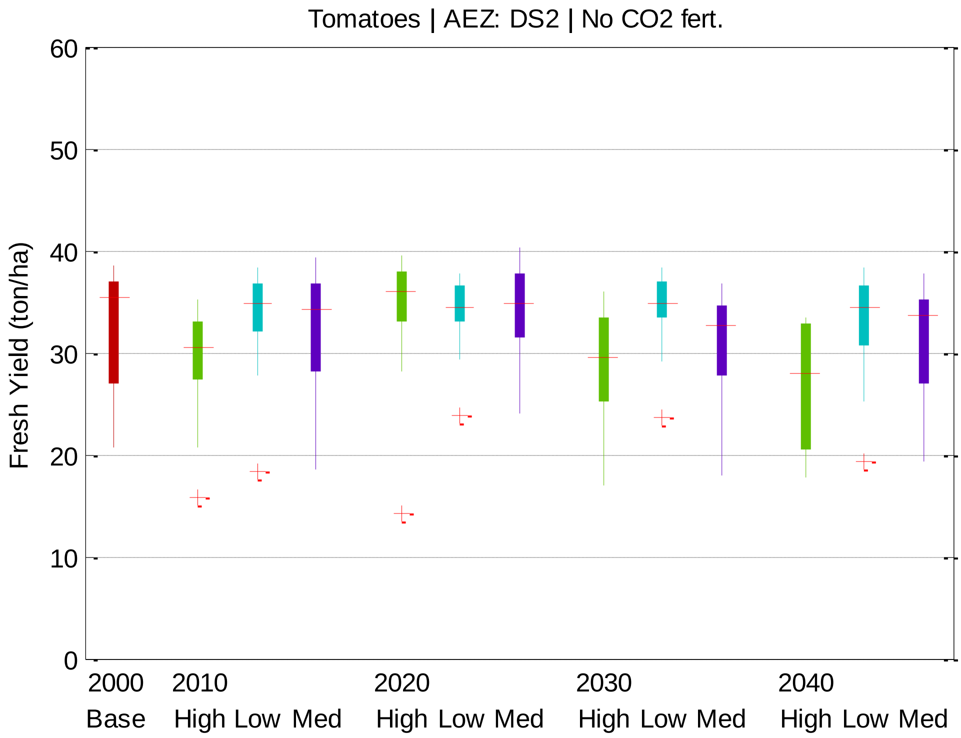

Table 1-49. Yield Statistics for Tomatoes, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	32.3	20.7	38.5	6.4
2010	High	28.8	15.8	35.2	6.3
2010	Low	33.0	18.4	38.3	6.0
2010	Med	31.6	18.5	39.3	7.4
2020	High	33.4	14.3	39.6	7.5
2020	Low	33.6	23.9	37.7	4.2
2020	Med	34.1	24.0	40.2	4.9
2030	High	28.3	17.0	35.9	6.2
2030	Low	34.0	23.7	38.3	4.5
2030	Med	30.3	18.0	36.7	6.1
2040	High	27.1	17.8	33.5	6.2
2040	Low	32.4	19.3	38.4	6.1
2040	Med	30.8	19.4	37.8	6.5

Figure 1-50. Yields for Tomatoes, AEZ: DS2 | CO2 fert.

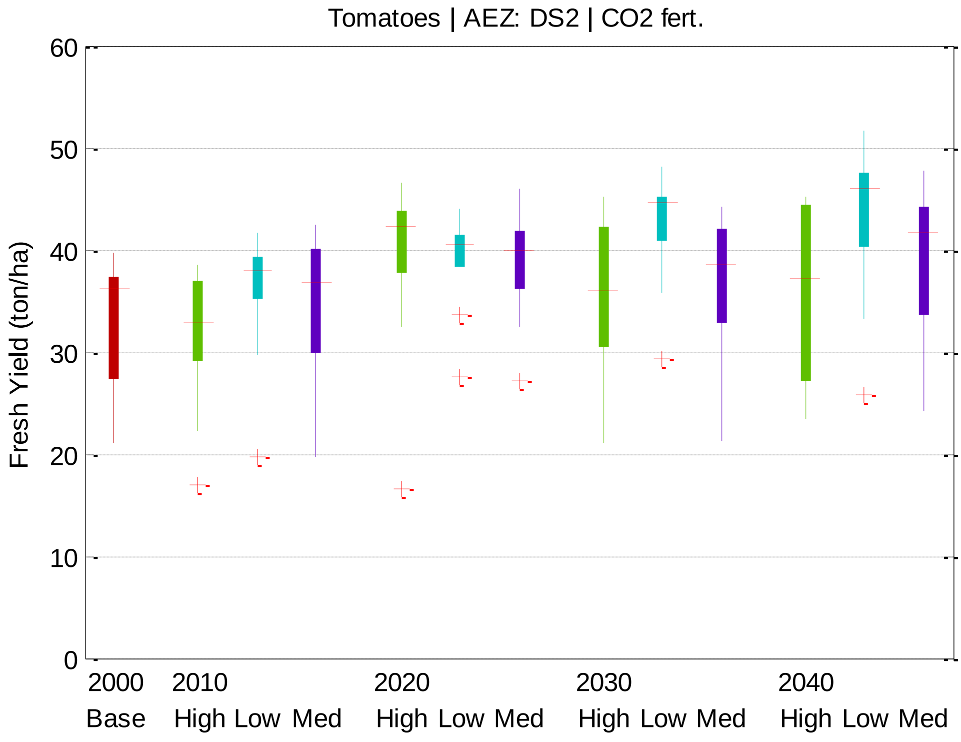

Table 1-50. Yield Statistics for Tomatoes, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	33.1	21.1	39.7	6.7
2010	High	31.3	16.9	38.6	7.1
2010	Low	35.6	19.8	41.7	6.5
2010	Med	33.9	19.7	42.5	8.1
2020	High	38.9	16.5	46.5	8.8
2020	Low	38.8	27.5	44.0	4.9
2020	Med	38.6	27.1	45.9	5.5
2030	High	35.4	21.0	45.2	8.1
2030	Low	42.2	29.3	48.2	5.7
2030	Med	36.2	21.3	44.2	7.4
2040	High	36.1	23.4	45.1	8.6
2040	Low	43.1	25.8	51.6	8.1
2040	Med	38.6	24.3	47.7	8.3

Figure 1-51. Yields for Tomatoes, AEZ: DS5 | No CO2 fert.

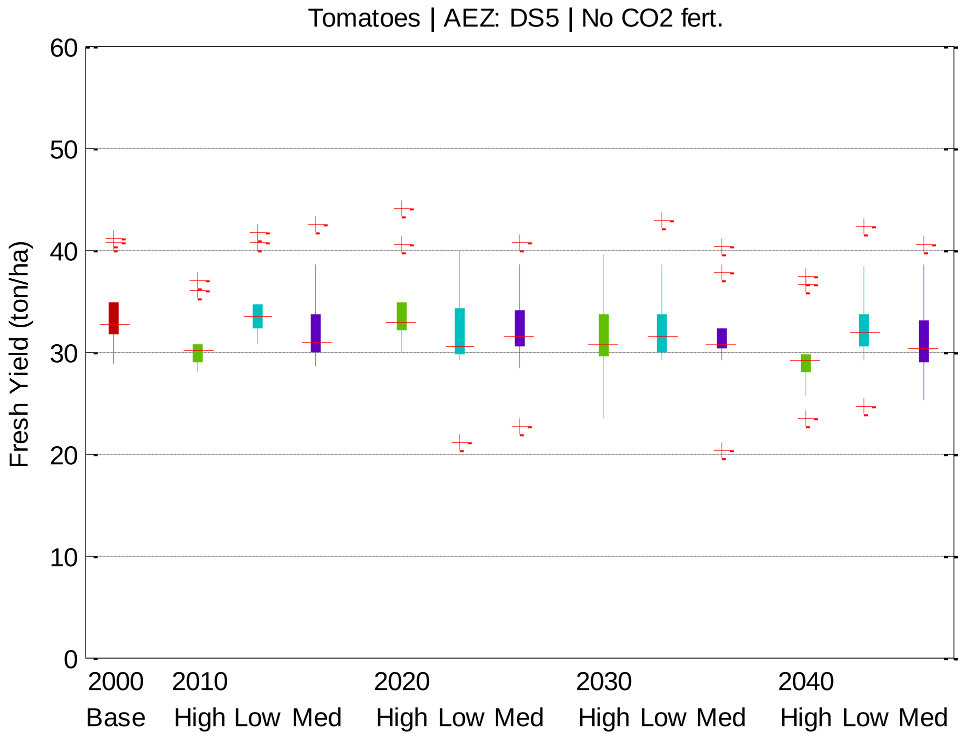

Table 1-51. Yield Statistics for Tomatoes, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	33.8	28.8	41.1	4.0
2010	High	31.0	28.0	36.9	3.0
2010	Low	34.3	30.6	41.6	3.8
2010	Med	32.9	28.5	42.5	4.4
2020	High	34.5	29.9	44.0	4.4
2020	Low	31.8	21.1	39.9	5.3
2020	Med	32.2	22.6	40.7	5.1
2030	High	31.2	23.5	39.5	5.0
2030	Low	33.0	29.1	42.8	4.4
2030	Med	31.3	20.2	40.3	5.3
2040	High	29.7	23.4	37.4	4.3
2040	Low	32.6	24.6	42.3	4.9
2040	Med	31.6	25.2	40.5	4.7

Figure 1-52. Yields for Tomatoes, AEZ: DS5 | CO2 fert.

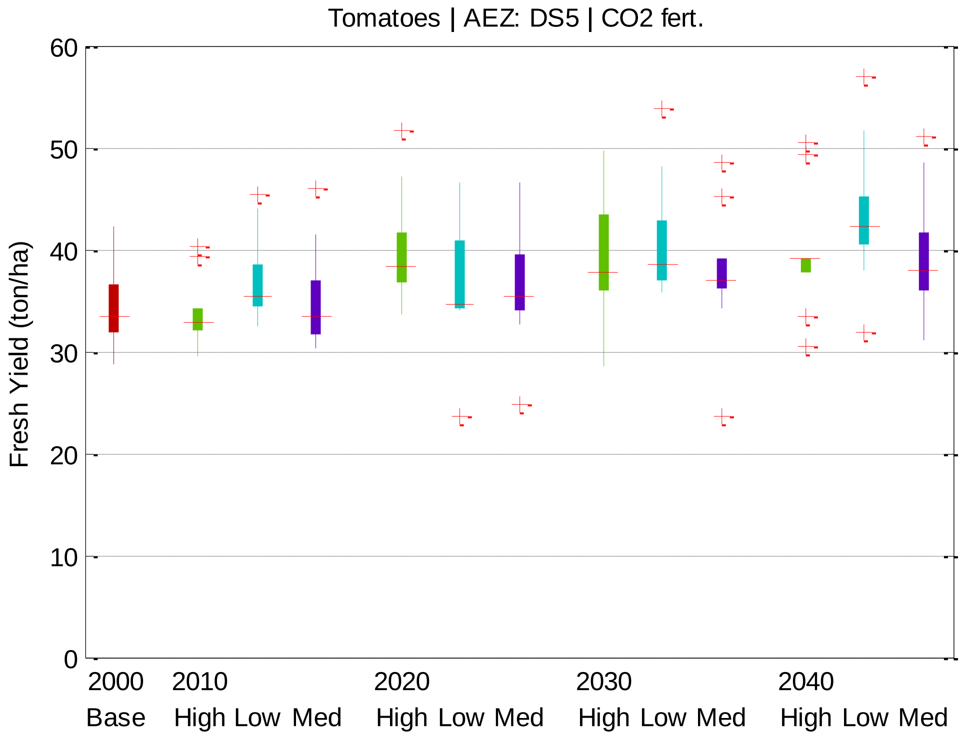

Table 1-52. Yield Statistics for Tomatoes, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	34.7	28.8	42.2	4.4
2010	High	33.7	29.5	40.2	3.5
2010	Low	37.1	32.4	45.3	4.3
2010	Med	35.3	30.2	45.9	5.0
2020	High	40.1	33.7	51.7	5.5
2020	Low	36.8	23.6	46.6	6.6
2020	Med	36.5	24.9	46.5	6.1
2030	High	39.1	28.5	49.8	6.6
2030	Low	41.0	35.8	53.8	5.9
2030	Med	37.5	23.6	48.5	6.6
2040	High	39.7	30.4	50.4	6.1
2040	Low	43.4	31.8	56.9	6.9
2040	Med	39.6	31.0	51.1	6.1

Figure 1-53. Yields for Tomatoes, AEZ: PI1 | No CO2 fert.

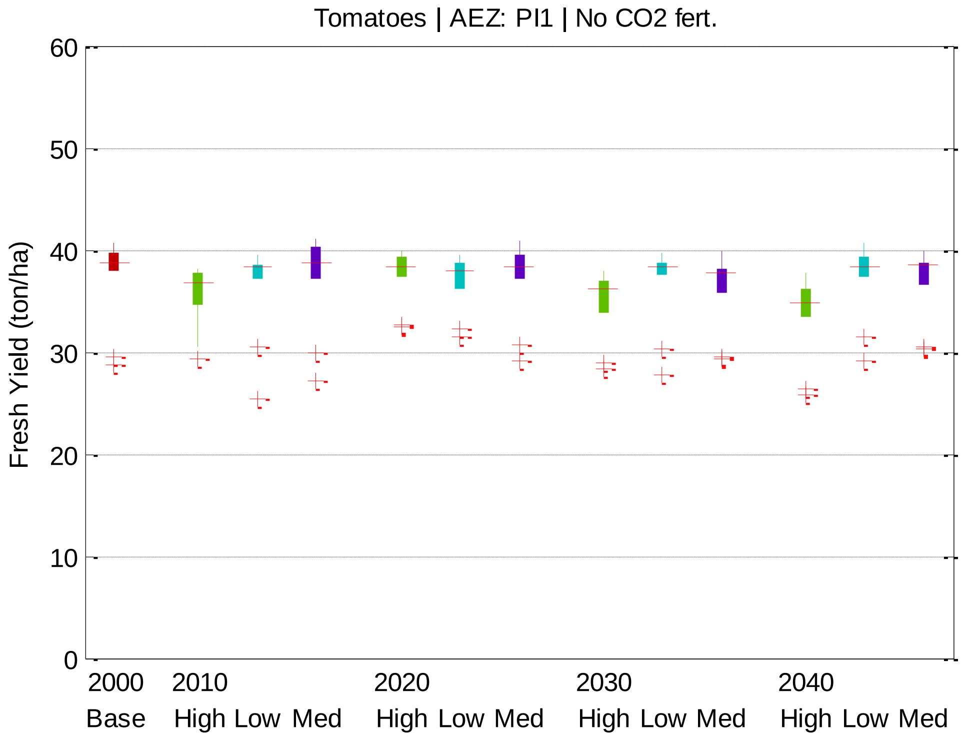

Table 1-53. Yield Statistics for Tomatoes, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	37.2	28.7	40.6	4.4
2010	High	35.5	29.4	38.2	3.2
2010	Low	36.2	25.4	39.5	4.6
2010	Med	37.1	27.1	41.0	4.7
2020	High	37.5	32.5	39.9	2.7
2020	Low	36.9	31.5	39.6	2.8
2020	Med	37.1	29.2	40.9	4.0
2030	High	34.9	28.4	37.9	3.5
2030	Low	36.7	27.7	39.8	4.2
2030	Med	36.1	29.3	40.0	3.7
2040	High	33.5	25.7	37.7	4.2
2040	Low	37.1	29.1	40.7	3.7
2040	Med	36.9	30.3	39.9	3.6

Figure 1-54. Yields for Tomatoes, AEZ: PI1 | CO2 fert.

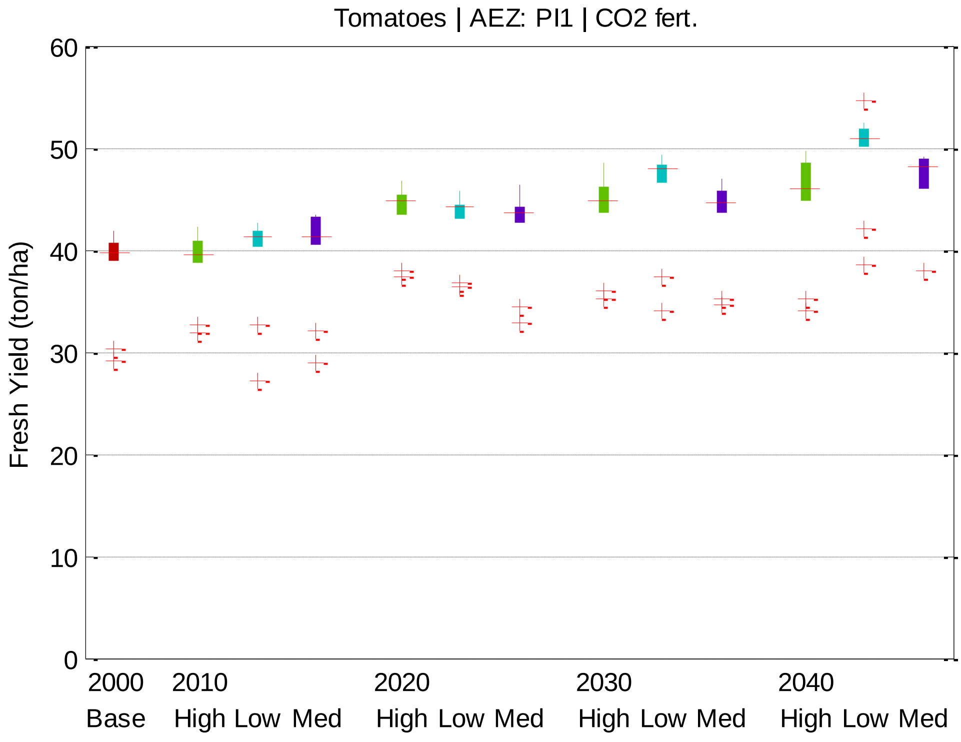

Table 1-54. Yield Statistics for Tomatoes, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	38.1	29.1	41.8	4.6
2010	High	38.6	31.8	42.3	3.5
2010	Low	39.2	27.2	42.6	5.1
2010	Med	39.8	28.9	43.5	5.1
2020	High	43.6	37.4	46.8	3.3
2020	Low	42.7	36.3	45.8	3.3
2020	Med	42.1	32.8	46.4	4.6
2030	High	43.5	35.1	48.5	4.5
2030	Low	45.6	34.0	49.3	5.3
2030	Med	43.2	34.7	46.9	4.5
2040	High	44.7	34.1	49.8	5.6
2040	Low	49.3	38.6	54.7	5.0
2040	Med	46.2	37.9	49.1	4.4

Figure 1-55. Yields for Tomatoes, AEZ: PI3 | No CO2 fert.

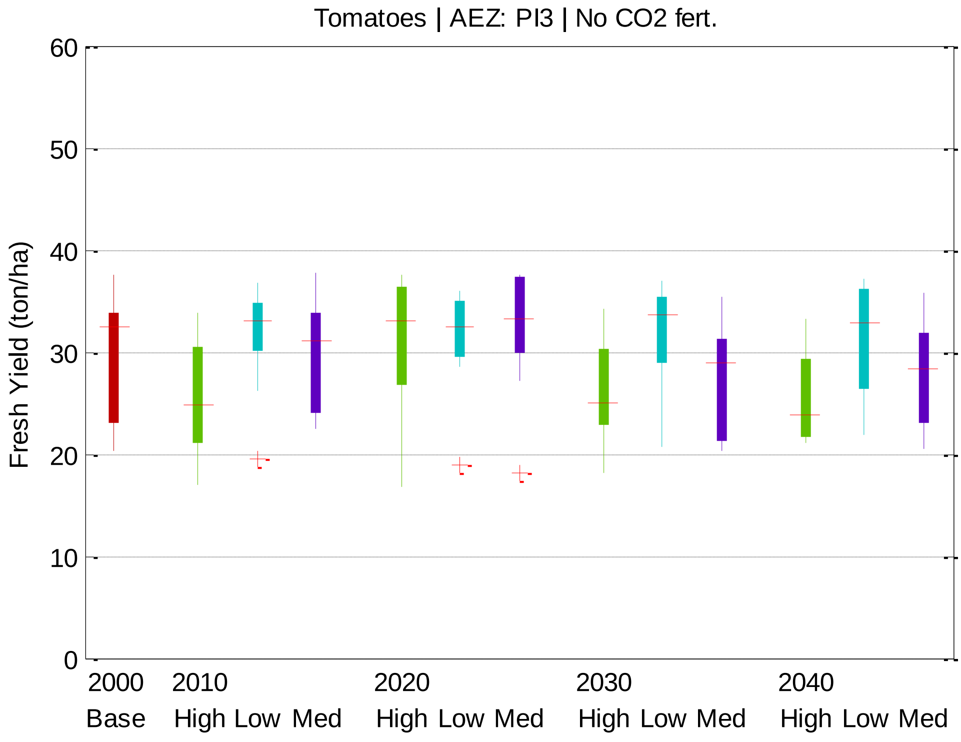

Table 1-55. Yield Statistics for Tomatoes, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	30.0	20.3	37.5	6.1
2010	High	25.4	17.0	33.9	6.0
2010	Low	31.5	19.6	36.8	5.2
2010	Med	29.9	22.5	37.7	5.8
2020	High	30.7	16.8	37.6	7.0
2020	Low	31.4	19.0	35.9	5.1
2020	Med	32.2	18.2	37.5	6.0
2030	High	26.0	18.2	34.3	5.2
2030	Low	31.9	20.7	37.0	5.1
2030	Med	27.5	20.3	35.3	5.7
2040	High	25.5	21.1	33.3	4.7
2040	Low	31.3	21.9	37.1	5.1
2040	Med	27.8	20.5	35.8	5.5

Figure 1-56. Yields for Tomatoes, AEZ: PI3 | CO2 fert.

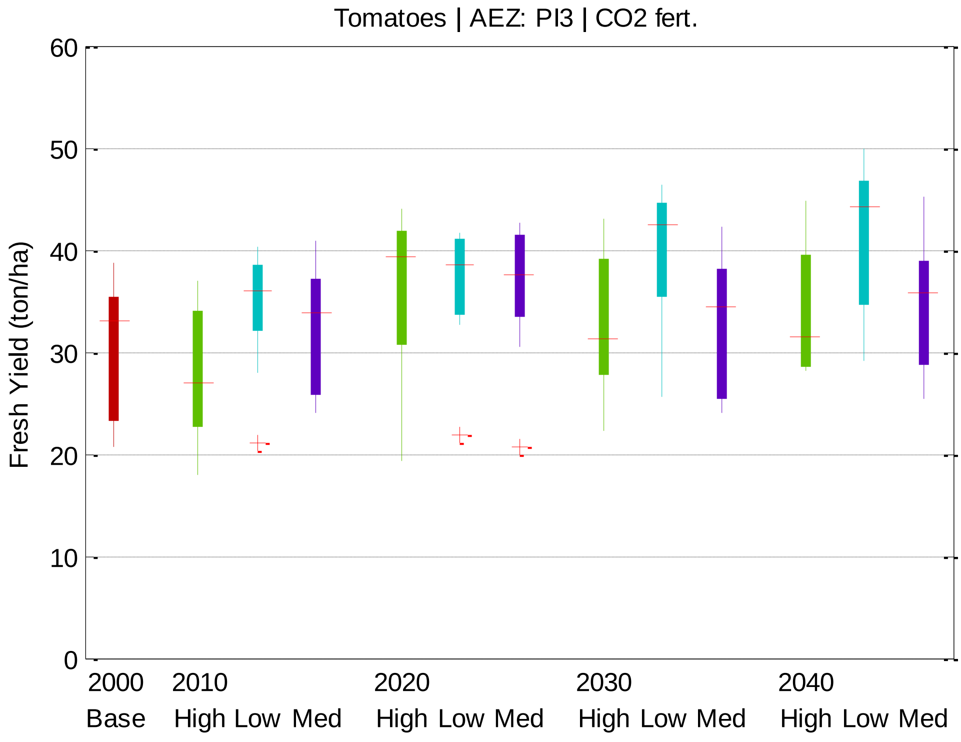

Table 1-56. Yield Statistics for Tomatoes, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	30.8	20.7	38.7	6.5
2010	High	27.6	18.0	36.9	6.8
2010	Low	34.1	21.0	40.2	5.9
2010	Med	32.1	24.1	40.8	6.4
2020	High	35.8	19.4	44.1	8.3
2020	Low	36.4	21.9	41.6	6.0
2020	Med	36.5	20.6	42.7	6.8
2030	High	32.6	22.3	43.0	6.9
2030	Low	39.7	25.6	46.4	6.6
2030	Med	33.0	24.1	42.3	7.1
2040	High	34.1	28.2	44.9	6.6
2040	Low	41.7	29.2	49.9	7.0
2040	Med	34.9	25.3	45.1	7.1

A.7 **Spring Wheat**

Figure 1-57. Yields for Wheat, AEZ: DS2 | No CO2 fert.

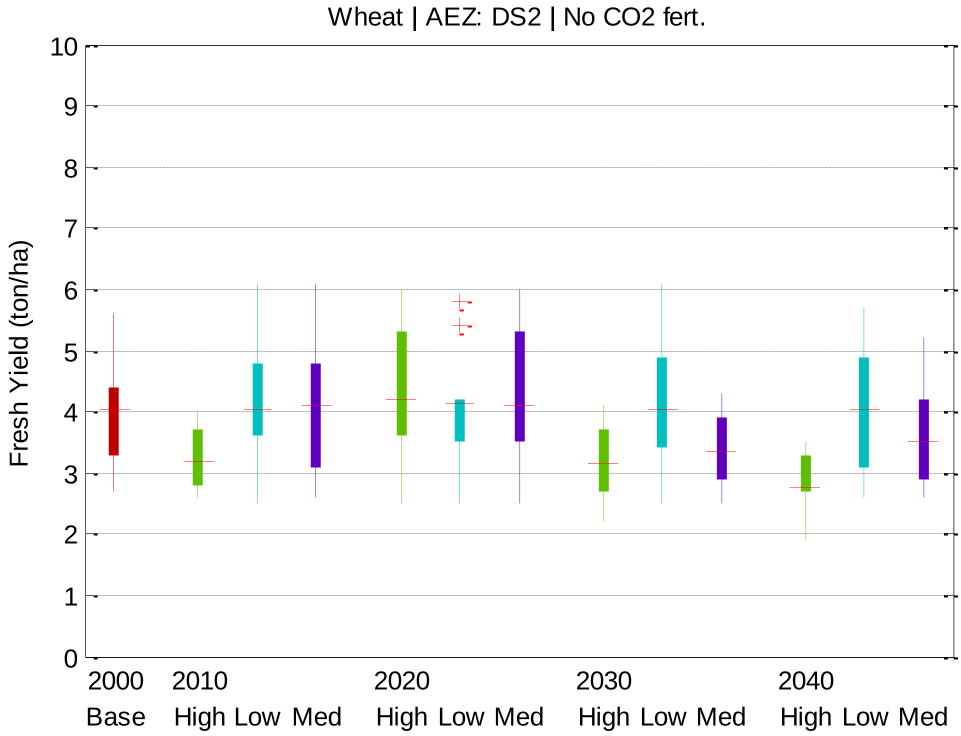

Table 1-57. Yield Statistics for Wheat, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.1	2.7	5.6	0.9
2010	High	3.2	2.6	4.0	0.5
2010	Low	4.2	2.5	6.1	1.1
2010	Med	4.1	2.6	6.1	1.1
2020	High	4.3	2.5	6.0	1.2
2020	Low	4.0	2.5	5.8	1.0
2020	Med	4.3	2.5	6.0	1.2
2030	High	3.2	2.2	4.1	0.7
2030	Low	4.2	2.5	6.1	1.2
2030	Med	3.4	2.5	4.3	0.6
2040	High	2.8	1.9	3.5	0.5
2040	Low	4.0	2.6	5.7	1.0
2040	Med	3.7	2.6	5.2	0.9

Figure 1-58. Yields for Wheat, AEZ: DS2 | CO2 fert.

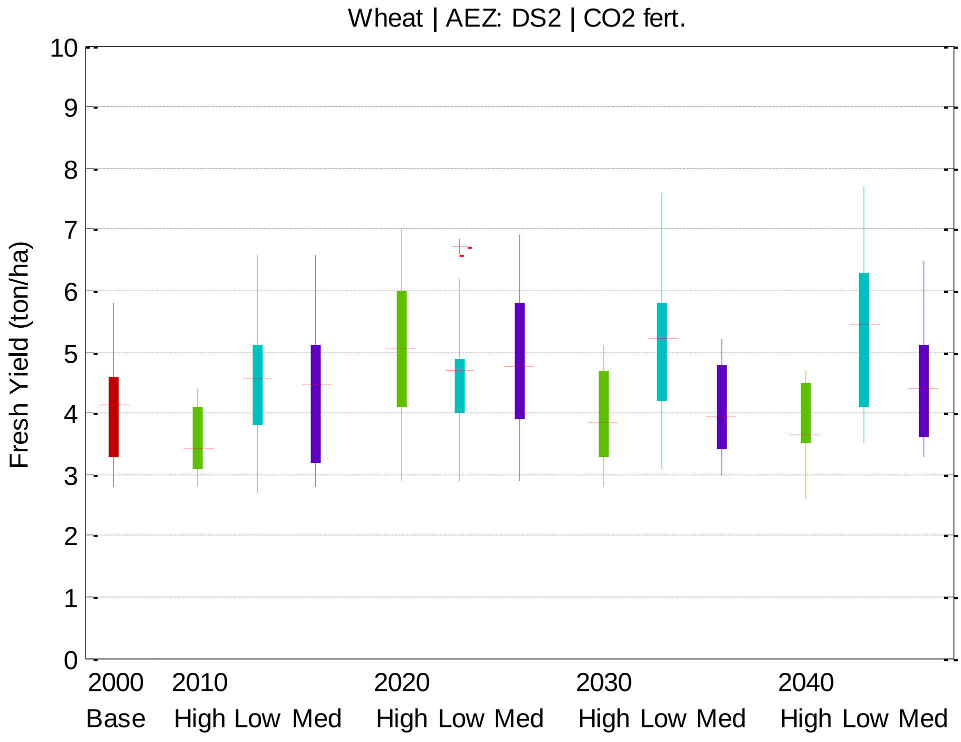

Table 1-58. Yield Statistics for Wheat, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.2	2.8	5.8	1.0
2010	High	3.5	2.8	4.4	0.6
2010	Low	4.5	2.7	6.6	1.2
2010	Med	4.4	2.8	6.6	1.2
2020	High	5.1	2.9	7.0	1.4
2020	Low	4.6	2.9	6.7	1.2
2020	Med	4.8	2.9	6.9	1.4
2030	High	3.9	2.8	5.1	0.8
2030	Low	5.2	3.1	7.6	1.4
2030	Med	4.0	3.0	5.2	0.7
2040	High	3.8	2.6	4.7	0.6
2040	Low	5.4	3.5	7.7	1.4
2040	Med	4.6	3.3	6.5	1.1

Figure 1-59. Yields for Wheat, AEZ: DS5 | No CO2 fert.

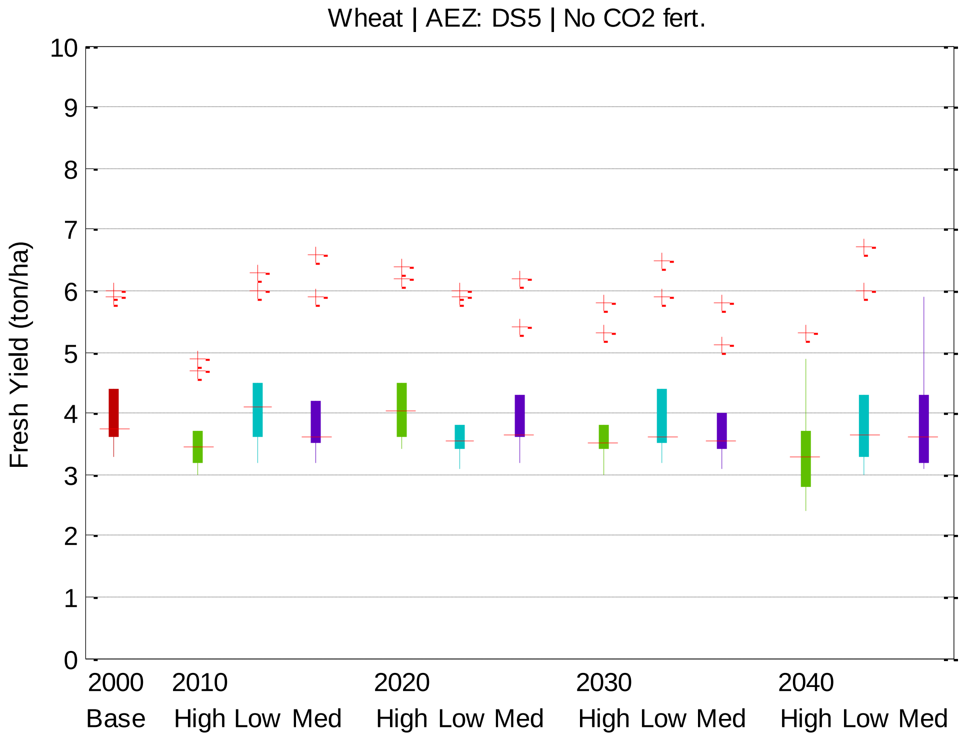

Table 1-59. Yield Statistics for Wheat, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.2	3.3	6.0	1.0
2010	High	3.6	3.0	4.9	0.6
2010	Low	4.3	3.2	6.3	1.0
2010	Med	4.2	3.2	6.6	1.1
2020	High	4.4	3.4	6.4	1.1
2020	Low	3.9	3.1	6.0	1.1
2020	Med	4.1	3.2	6.2	1.0
2030	High	3.9	3.0	5.8	0.9
2030	Low	4.2	3.2	6.5	1.1
2030	Med	3.9	3.1	5.8	0.9
2040	High	3.5	2.4	5.3	0.9
2040	Low	4.1	3.0	6.7	1.2
2040	Med	3.9	3.1	5.9	0.9

Figure 1-60. Yields for Wheat, AEZ: DS5 | CO2 fert.

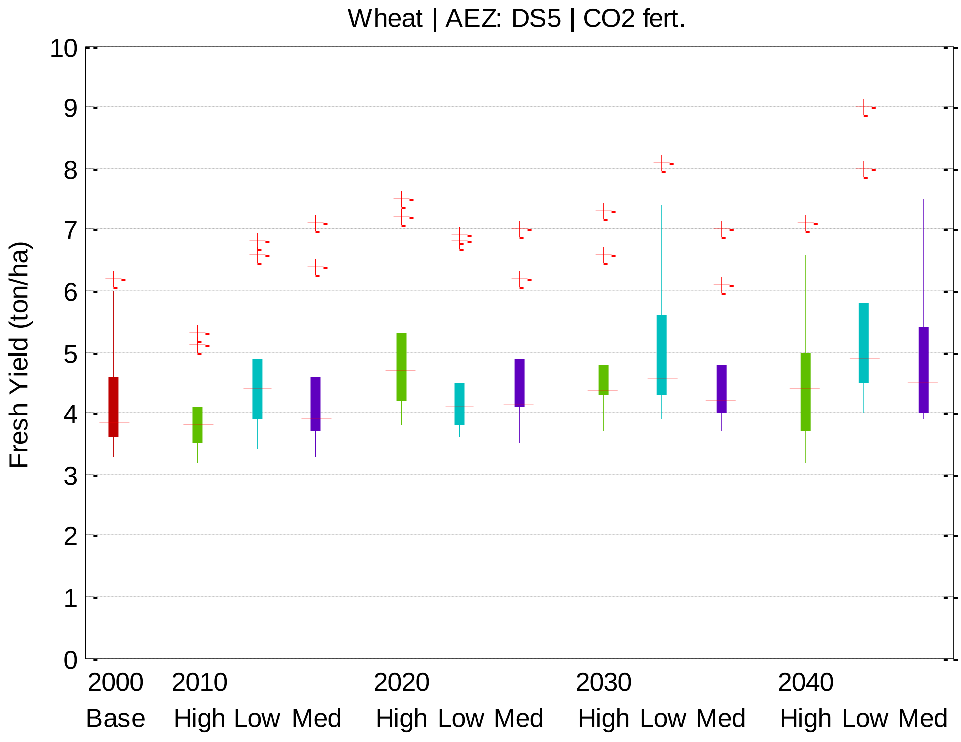

Table 1-60. Yield Statistics for Wheat, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.2	3.3	6.2	1.0
2010	High	4.0	3.2	5.3	0.7
2010	Low	4.7	3.4	6.8	1.1
2010	Med	4.5	3.3	7.1	1.3
2020	High	5.1	3.8	7.5	1.3
2020	Low	4.6	3.6	6.9	1.2
2020	Med	4.6	3.5	7.0	1.1
2030	High	4.8	3.7	7.3	1.2
2030	Low	5.2	3.9	8.1	1.4
2030	Med	4.6	3.7	7.0	1.1
2040	High	4.6	3.2	7.1	1.3
2040	Low	5.5	4.0	9.0	1.7
2040	Med	4.9	3.9	7.5	1.2

Figure 1-61. Yields for Wheat, AEZ: HI3 | No CO2 fert.

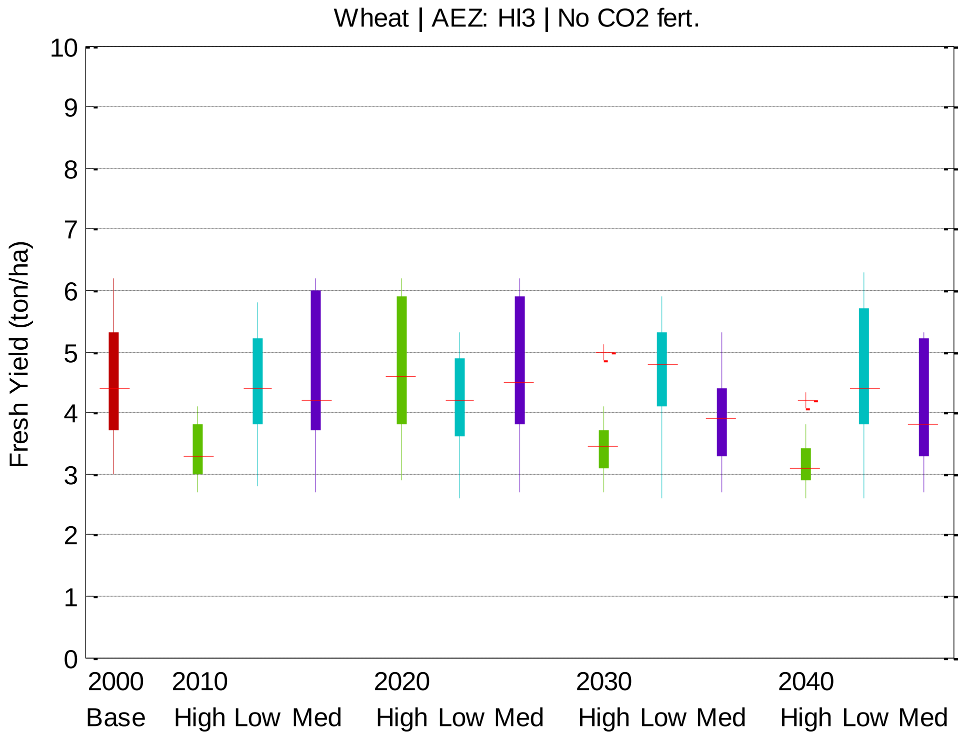

Table 1-61. Yield Statistics for Wheat, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.6	3.0	6.2	1.1
2010	High	3.4	2.7	4.1	0.5
2010	Low	4.4	2.8	5.8	0.9
2010	Med	4.6	2.7	6.2	1.3
2020	High	4.7	2.9	6.2	1.2
2020	Low	4.2	2.6	5.3	0.9
2020	Med	4.7	2.7	6.2	1.3
2030	High	3.5	2.7	5.0	0.7
2030	Low	4.6	2.6	5.9	1.1
2030	Med	4.0	2.7	5.3	0.8
2040	High	3.2	2.6	4.2	0.5
2040	Low	4.5	2.6	6.3	1.2
2040	Med	4.0	2.7	5.3	1.0

Figure 1-62. Yields for Wheat, AEZ: HI3 | CO2 fert.

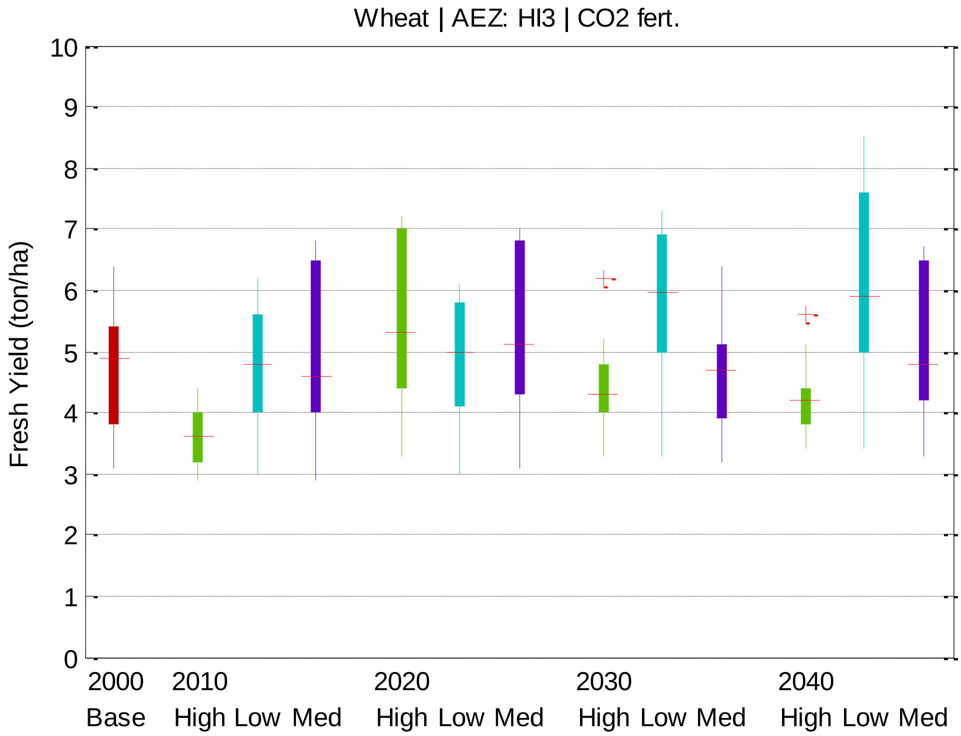

Table 1-62. Yield Statistics for Wheat, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.8	3.1	6.4	1.1
2010	High	3.7	2.9	4.4	0.5
2010	Low	4.7	3.0	6.2	1.0
2010	Med	5.0	2.9	6.8	1.4
2020	High	5.5	3.3	7.2	1.5
2020	Low	4.8	3.0	6.1	1.0
2020	Med	5.4	3.1	7.0	1.4
2030	High	4.4	3.3	6.2	0.8
2030	Low	5.8	3.3	7.3	1.4
2030	Med	4.7	3.2	6.4	1.0
2040	High	4.3	3.4	5.6	0.7
2040	Low	6.0	3.4	8.5	1.7
2040	Med	5.0	3.3	6.7	1.3

Figure 1-63. Yields for Wheat, AEZ: PI1 | No CO2 fert.

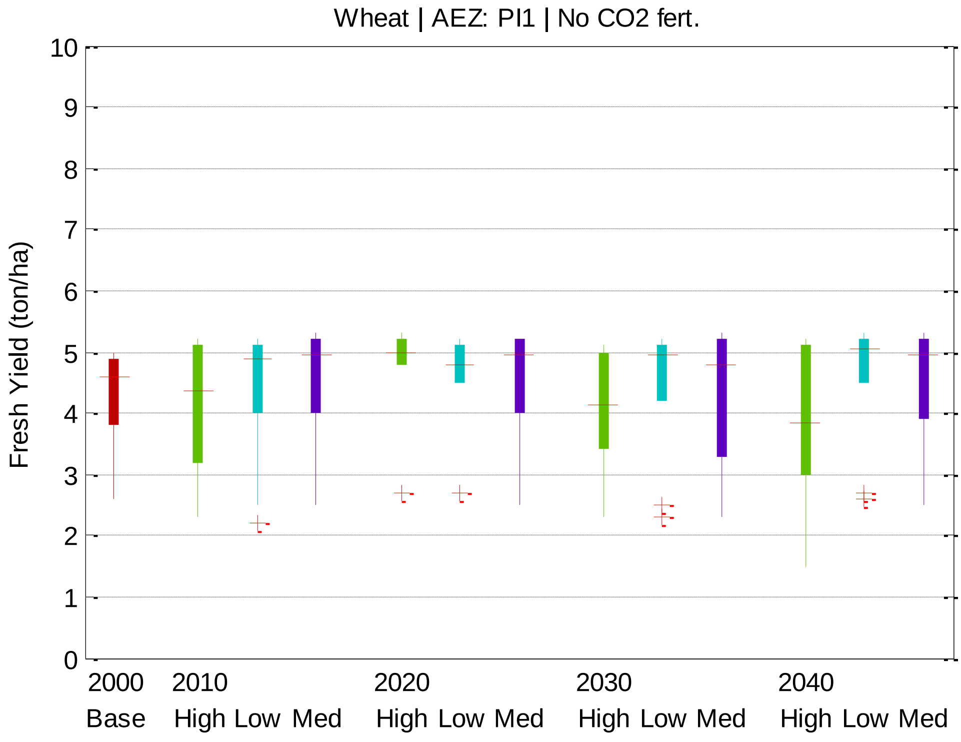

Table 1-63. Yield Statistics for Wheat, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.2	2.6	5.0	0.9
2010	High	4.0	2.3	5.2	1.1
2010	Low	4.4	2.2	5.2	1.1
2010	Med	4.5	2.5	5.3	1.1
2020	High	4.6	2.7	5.3	1.0
2020	Low	4.5	2.7	5.2	1.0
2020	Med	4.4	2.5	5.2	1.1
2030	High	4.0	2.3	5.1	1.1
2030	Low	4.4	2.3	5.2	1.1
2030	Med	4.2	2.3	5.3	1.2
2040	High	3.8	1.5	5.2	1.4
2040	Low	4.5	2.6	5.3	1.0
2040	Med	4.5	2.5	5.3	1.1

Figure 1-64. Yields for Wheat, AEZ: PI1 | CO2 fert.

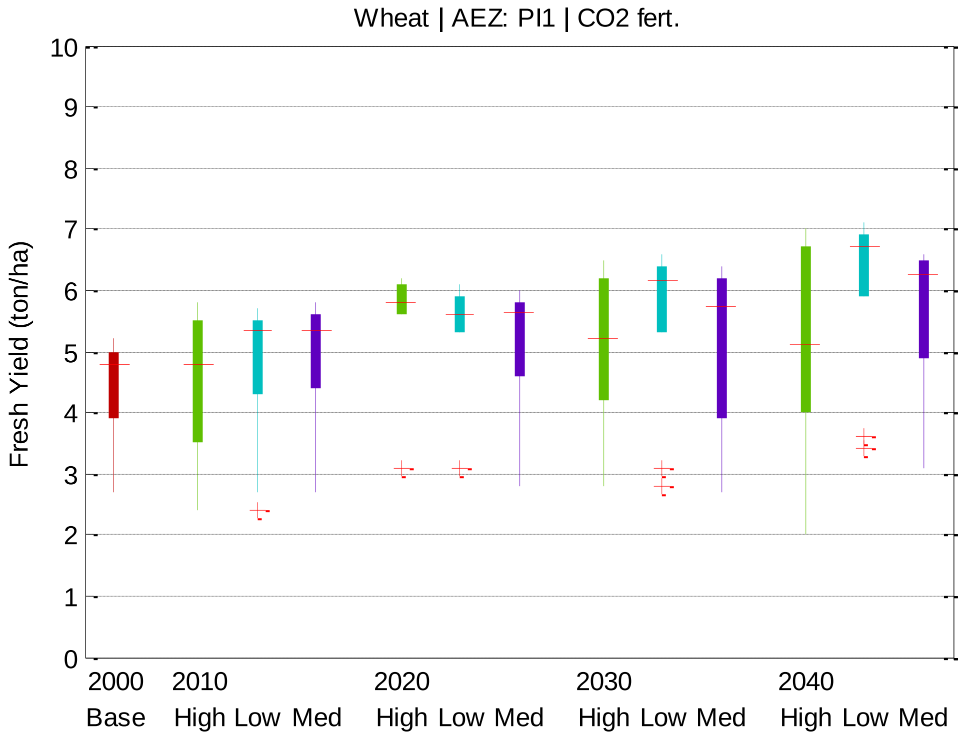

Table 1-64. Yield Statistics for Wheat, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.4	2.7	5.2	0.9
2010	High	4.4	2.4	5.8	1.2
2010	Low	4.7	2.4	5.7	1.2
2010	Med	4.8	2.7	5.8	1.2
2020	High	5.4	3.1	6.2	1.2
2020	Low	5.2	3.1	6.1	1.1
2020	Med	5.0	2.8	6.0	1.2
2030	High	5.0	2.8	6.5	1.4
2030	Low	5.5	2.8	6.6	1.4
2030	Med	5.0	2.7	6.4	1.4
2040	High	5.0	2.0	7.0	1.9
2040	Low	6.0	3.4	7.1	1.4
2040	Med	5.6	3.1	6.6	1.3

Figure 1-65. Yields for Wheat, AEZ: PI3 | No CO2 fert.

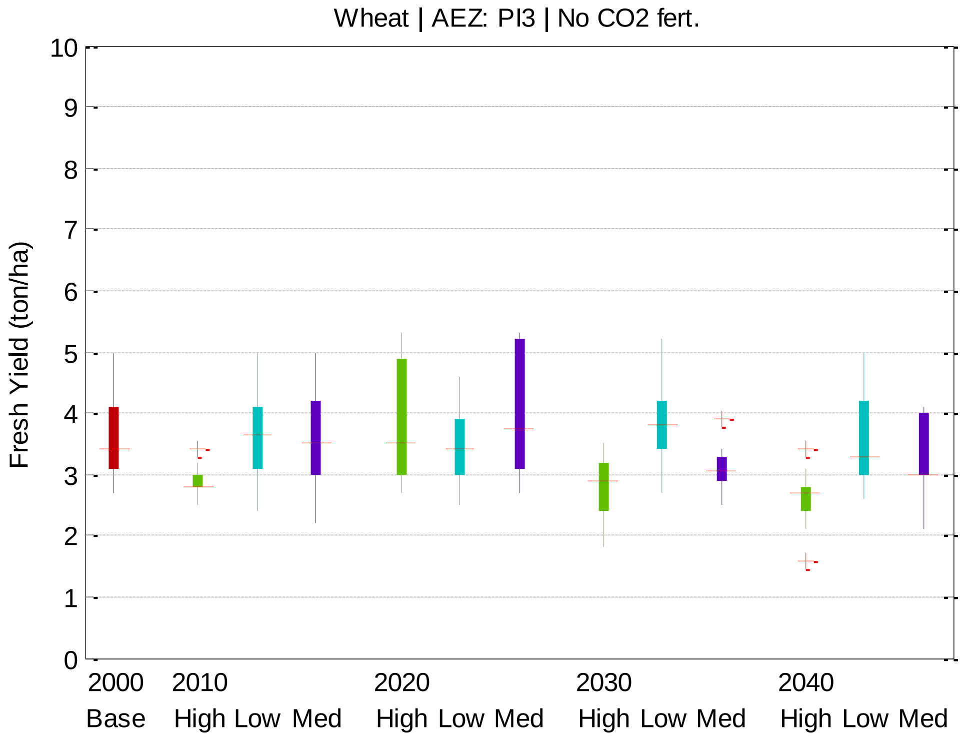

Table 1-65. Yield Statistics for Wheat, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.7	2.7	5.0	0.8
2010	High	2.9	2.5	3.4	0.3
2010	Low	3.7	2.4	5.0	0.8
2010	Med	3.6	2.2	5.0	0.9
2020	High	3.8	2.7	5.3	1.0
2020	Low	3.5	2.5	4.6	0.6
2020	Med	4.0	2.7	5.3	1.0
2030	High	2.8	1.8	3.5	0.5
2030	Low	3.9	2.7	5.2	0.8
2030	Med	3.1	2.5	3.9	0.4
2040	High	2.6	1.6	3.4	0.5
2040	Low	3.6	2.6	5.0	0.8
2040	Med	3.2	2.1	4.1	0.7

Figure 1-66. Yields for Wheat, AEZ: PI3 | CO2 fert.

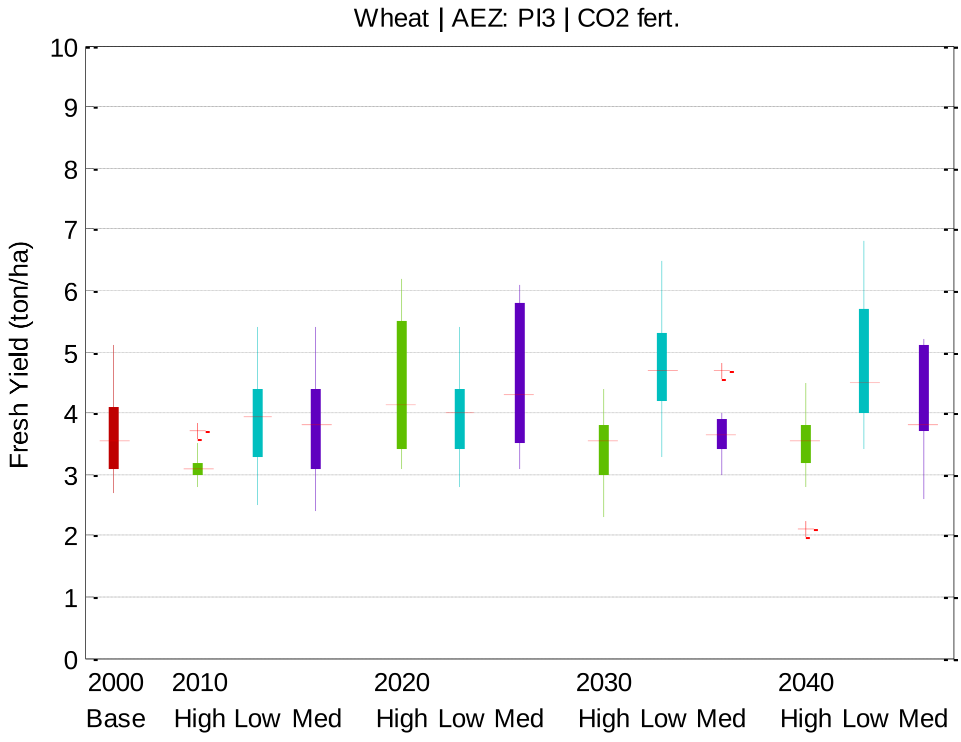

Table 1-66. Yield Statistics for Wheat, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.7	2.7	5.1	0.8
2010	High	3.1	2.8	3.7	0.3
2010	Low	4.0	2.5	5.4	0.9
2010	Med	3.9	2.4	5.4	1.0
2020	High	4.4	3.1	6.2	1.1
2020	Low	4.0	2.8	5.4	0.8
2020	Med	4.5	3.1	6.1	1.1
2030	High	3.5	2.3	4.4	0.6
2030	Low	4.8	3.3	6.5	1.0
2030	Med	3.7	3.0	4.7	0.5
2040	High	3.5	2.1	4.5	0.7
2040	Low	4.8	3.4	6.8	1.1
2040	Med	4.0	2.6	5.2	0.9

A.8 Winter Wheat

Figure 1-1. Yields for Winter wheat, AEZ: DS2 | No CO2 fert.

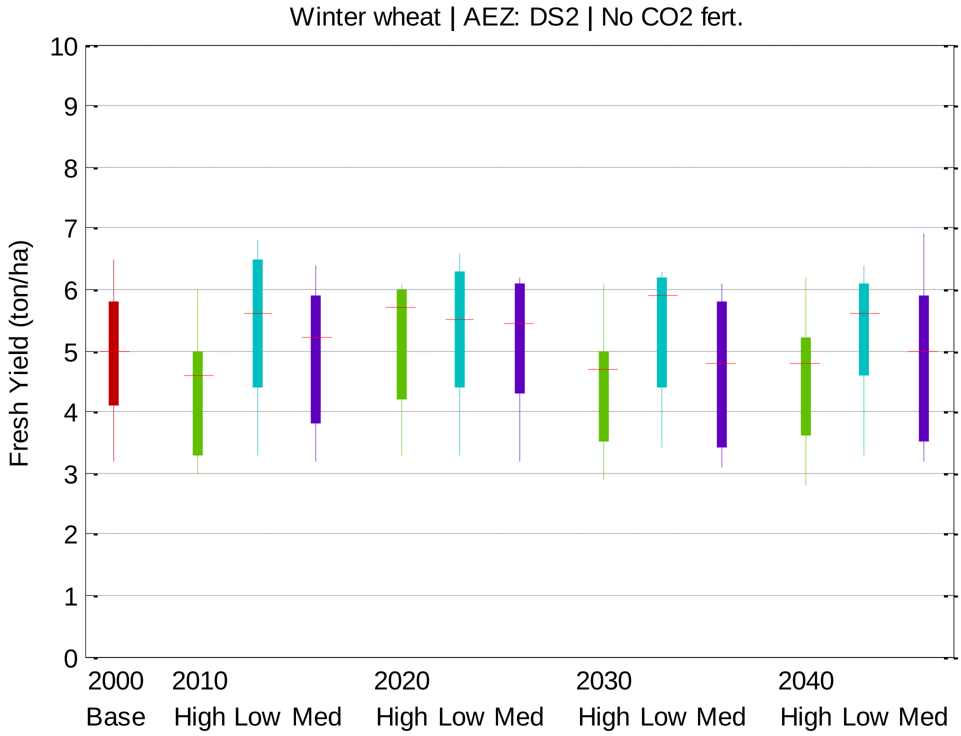

Table 1-1. Yield Statistics for Winter wheat, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.9	3.2	6.5	1.1
2010	High	4.4	3.0	6.0	1.0
2010	Low	5.4	3.3	6.8	1.3
2010	Med	5.0	3.2	6.4	1.2
2020	High	5.1	3.3	6.1	1.1
2020	Low	5.3	3.3	6.6	1.2
2020	Med	5.1	3.2	6.2	1.2
2030	High	4.5	2.9	6.1	1.1
2030	Low	5.3	3.4	6.3	1.2
2030	Med	4.7	3.1	6.1	1.2
2040	High	4.5	2.8	6.2	1.1
2040	Low	5.2	3.3	6.4	1.2
2040	Med	5.0	3.2	6.9	1.3

Figure 1-2. Yields for Winter wheat, AEZ: DS2 | CO2 fert.

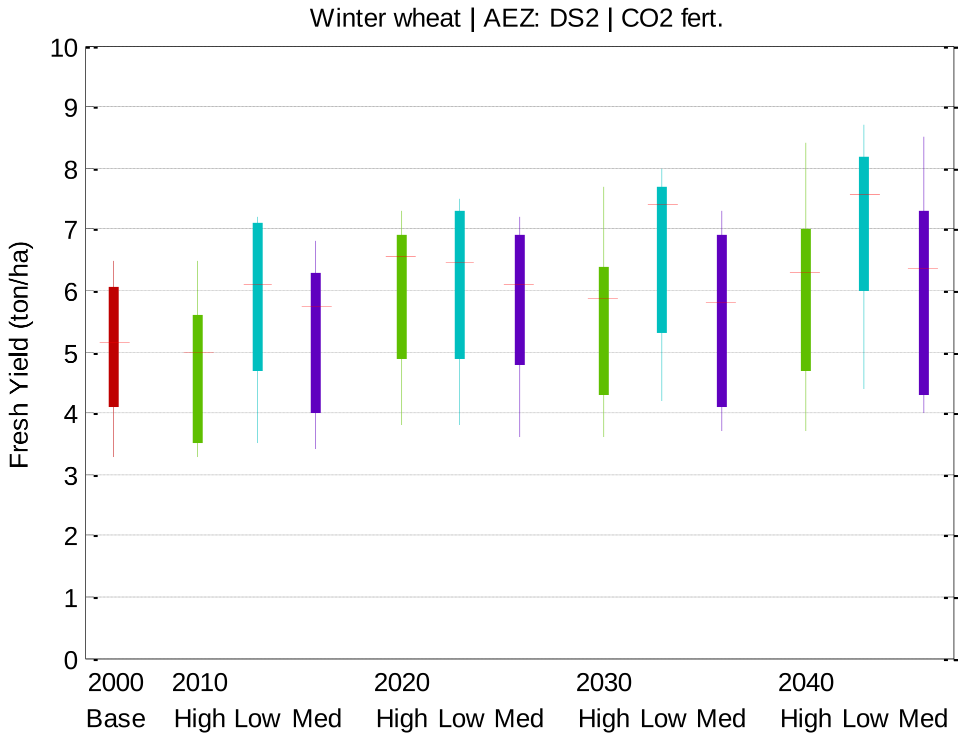

Table 1-2. Yield Statistics for Winter wheat, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	5.0	3.3	6.5	1.1
2010	High	4.8	3.3	6.5	1.1
2010	Low	5.8	3.5	7.2	1.5
2010	Med	5.3	3.4	6.8	1.3
2020	High	6.0	3.8	7.3	1.3
2020	Low	6.1	3.8	7.5	1.4
2020	Med	5.8	3.6	7.2	1.4
2030	High	5.6	3.6	7.7	1.5
2030	Low	6.6	4.2	8.0	1.5
2030	Med	5.6	3.7	7.3	1.4
2040	High	5.9	3.7	8.4	1.6
2040	Low	7.0	4.4	8.7	1.5
2040	Med	6.2	4.0	8.5	1.6

Figure 1-3. Yields for Winter wheat, AEZ: DS5 | No CO2 fert.

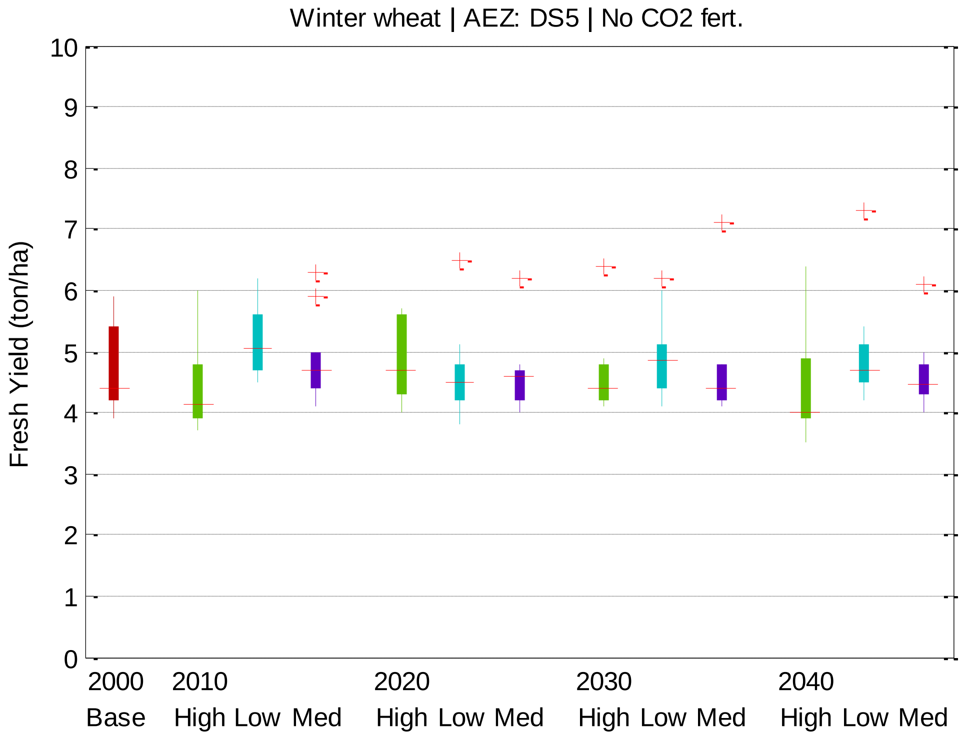

Table 1-3. Yield Statistics for Winter wheat, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.7	3.9	5.9	0.7
2010	High	4.5	3.7	6.0	0.8
2010	Low	5.2	4.5	6.2	0.6
2010	Med	4.9	4.1	6.3	0.7
2020	High	4.8	4.0	5.7	0.6
2020	Low	4.7	3.8	6.5	0.8
2020	Med	4.6	4.0	6.2	0.6
2030	High	4.6	4.1	6.4	0.7
2030	Low	4.9	4.1	6.2	0.7
2030	Med	4.7	4.1	7.1	0.9
2040	High	4.5	3.5	6.4	0.9
2040	Low	5.0	4.2	7.3	0.9
2040	Med	4.6	4.0	6.1	0.6

Figure 1-4. Yields for Winter wheat, AEZ: DS5 | CO2 fert.

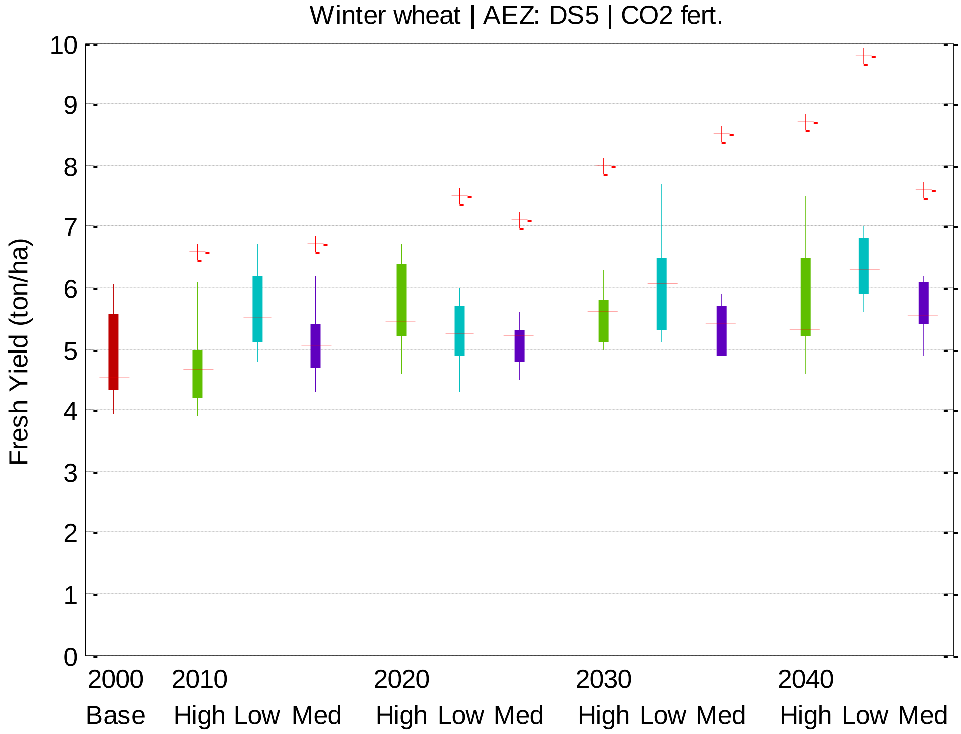

Table 1-4. Yield Statistics for Winter wheat, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	4.8	4.0	6.1	0.7
2010	High	4.9	3.9	6.6	0.9
2010	Low	5.6	4.8	6.7	0.6
2010	Med	5.2	4.3	6.7	0.7
2020	High	5.6	4.6	6.7	0.7
2020	Low	5.4	4.3	7.5	0.9
2020	Med	5.2	4.5	7.1	0.7
2030	High	5.7	5.0	8.0	0.9
2030	Low	6.1	5.1	7.7	0.9
2030	Med	5.6	4.9	8.5	1.1
2040	High	6.0	4.6	8.7	1.3
2040	Low	6.6	5.6	9.8	1.2
2040	Med	5.8	4.9	7.6	0.8

Figure 1-5. Yields for Winter wheat, AEZ: HI3 | No CO2 fert.

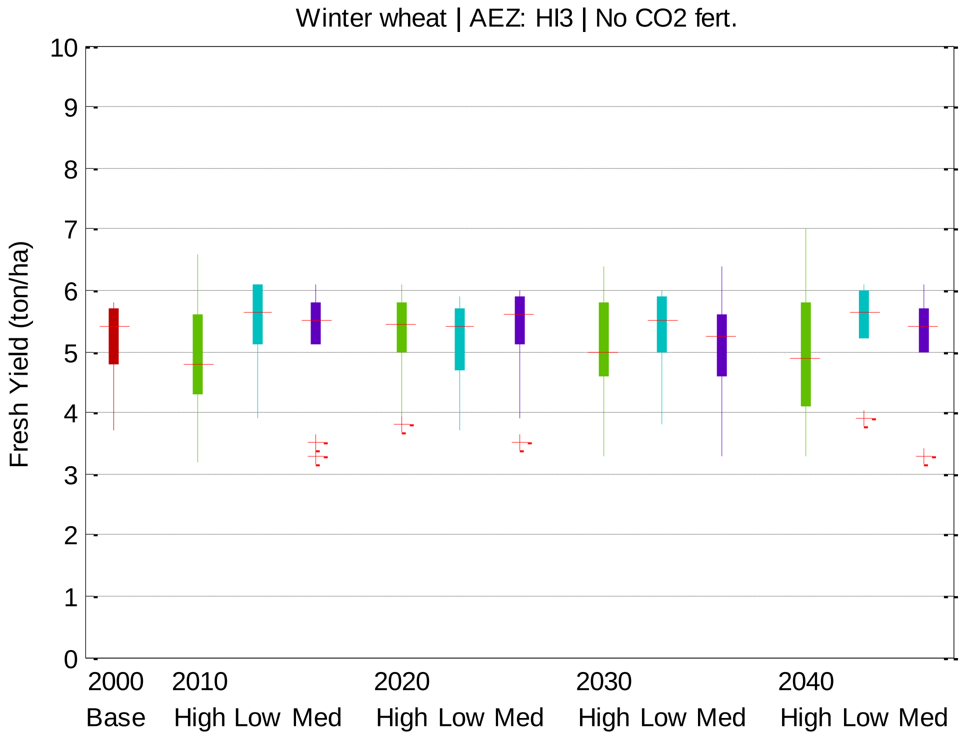

Table 1-5. Yield Statistics for Winter wheat, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	5.1	3.7	5.8	0.8
2010	High	4.8	3.2	6.6	1.1
2010	Low	5.4	3.9	6.1	0.8
2010	Med	5.2	3.3	6.1	1.0
2020	High	5.3	3.8	6.1	0.8
2020	Low	5.1	3.7	5.9	0.8
2020	Med	5.3	3.5	6.0	0.9
2030	High	5.0	3.3	6.4	1.0
2030	Low	5.3	3.8	6.0	0.8
2030	Med	5.0	3.3	6.4	1.0
2040	High	5.0	3.3	7.0	1.3
2040	Low	5.4	3.9	6.1	0.8
2040	Med	5.1	3.3	6.1	1.0

Figure 1-6. Yields for Winter wheat, AEZ: HI3 | CO2 fert.

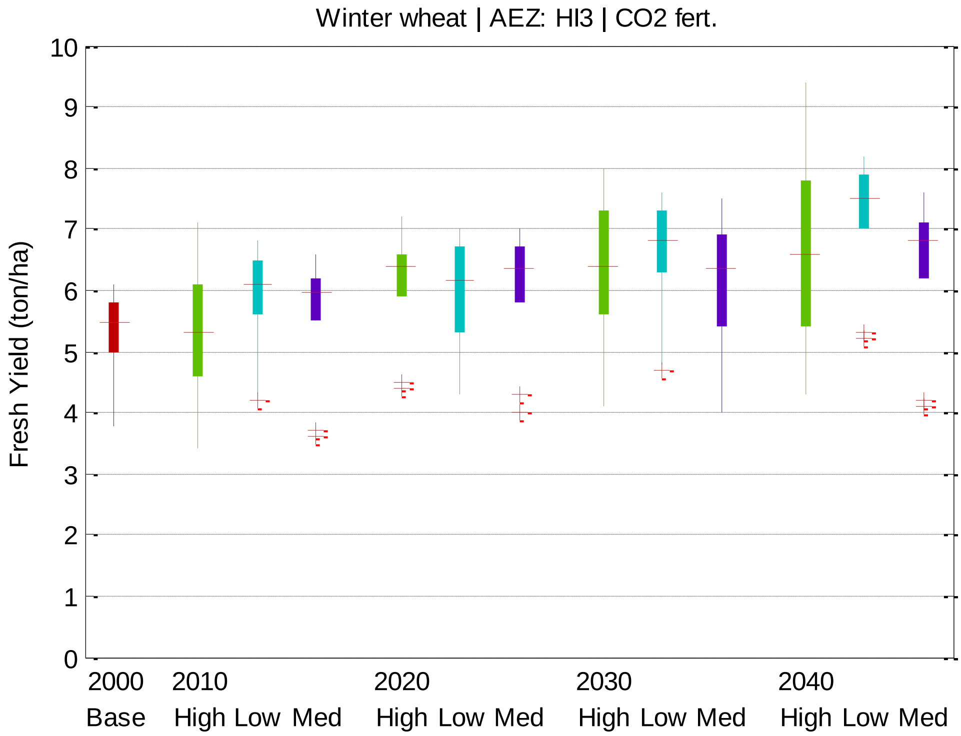

Table 1-6. Yield Statistics for Winter wheat, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	5.3	3.8	6.1	0.8
2010	High	5.3	3.4	7.1	1.2
2010	Low	5.8	4.2	6.8	0.9
2010	Med	5.6	3.6	6.6	1.0
2020	High	6.1	4.4	7.2	1.0
2020	Low	5.9	4.3	7.0	1.0
2020	Med	6.0	4.0	7.0	1.0
2030	High	6.3	4.1	8.0	1.3
2030	Low	6.5	4.7	7.6	1.0
2030	Med	6.0	4.0	7.5	1.2
2040	High	6.7	4.3	9.4	1.7
2040	Low	7.2	5.2	8.2	1.1
2040	Med	6.4	4.1	7.6	1.3

Figure 1-7. Yields for Winter wheat, AEZ: PI1 | No CO2 fert.

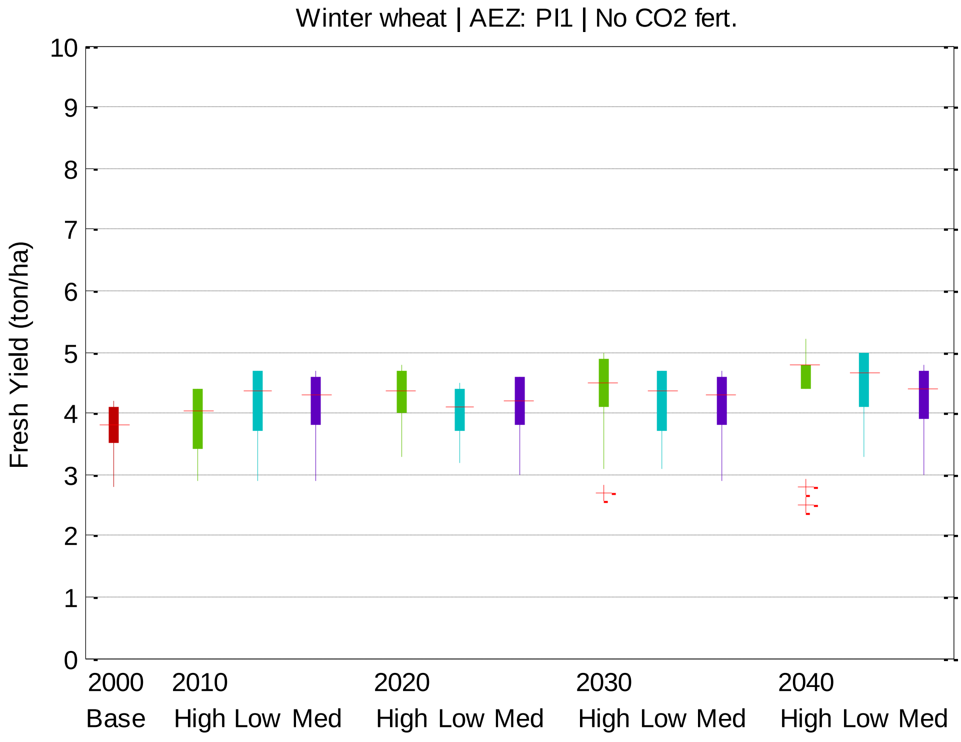

Table 1-7. Yield Statistics for Winter wheat, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.7	2.8	4.2	0.5
2010	High	3.8	2.9	4.4	0.6
2010	Low	4.1	2.9	4.7	0.6
2010	Med	4.0	2.9	4.7	0.6
2020	High	4.2	3.3	4.8	0.5
2020	Low	4.0	3.2	4.5	0.4
2020	Med	4.0	3.0	4.6	0.6
2030	High	4.2	2.7	5.0	0.8
2030	Low	4.1	3.1	4.7	0.6
2030	Med	4.1	2.9	4.7	0.6
2040	High	4.4	2.5	5.2	0.9
2040	Low	4.5	3.3	5.0	0.6
2040	Med	4.2	3.0	4.8	0.6

Figure 1-8. Yields for Winter wheat, AEZ: PI1 | CO2 fert.

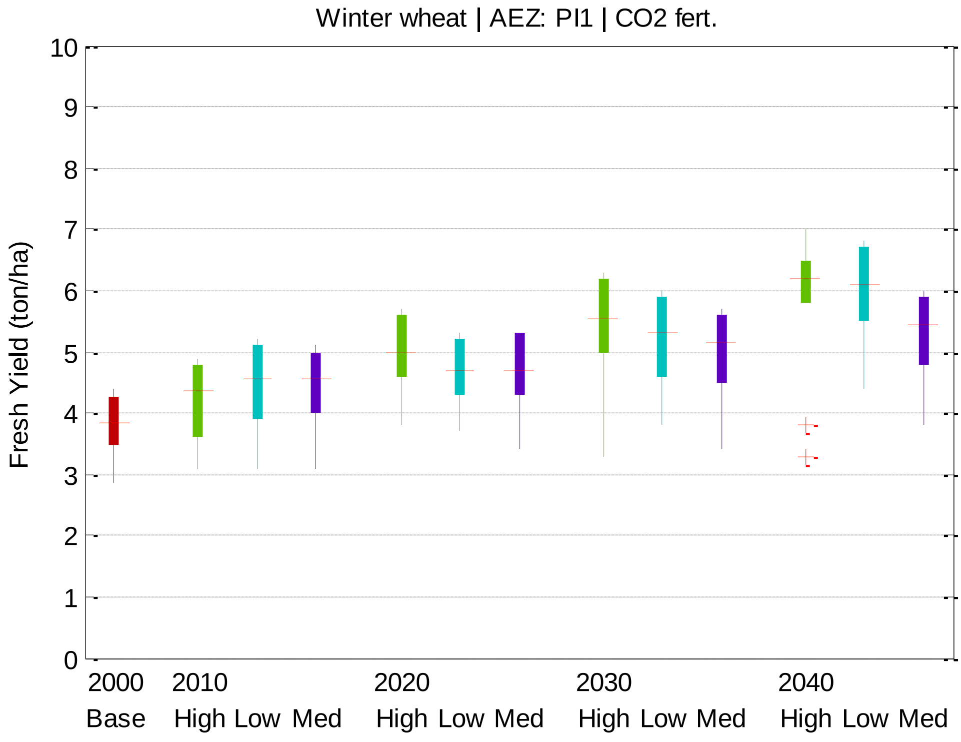

Table 1-8. Yield Statistics for Winter wheat, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	3.8	2.9	4.4	0.5
2010	High	4.2	3.1	4.9	0.7
2010	Low	4.4	3.1	5.2	0.7
2010	Med	4.4	3.1	5.1	0.7
2020	High	5.0	3.8	5.7	0.6
2020	Low	4.7	3.7	5.3	0.5
2020	Med	4.6	3.4	5.3	0.7
2030	High	5.3	3.3	6.3	1.0
2030	Low	5.2	3.8	6.0	0.8
2030	Med	4.9	3.4	5.7	0.8
2040	High	5.8	3.3	7.0	1.3
2040	Low	6.0	4.4	6.8	0.8
2040	Med	5.2	3.8	6.0	0.8

Figure 1-9. Yields for Winter wheat, AEZ: PI3 | No CO2 fert.

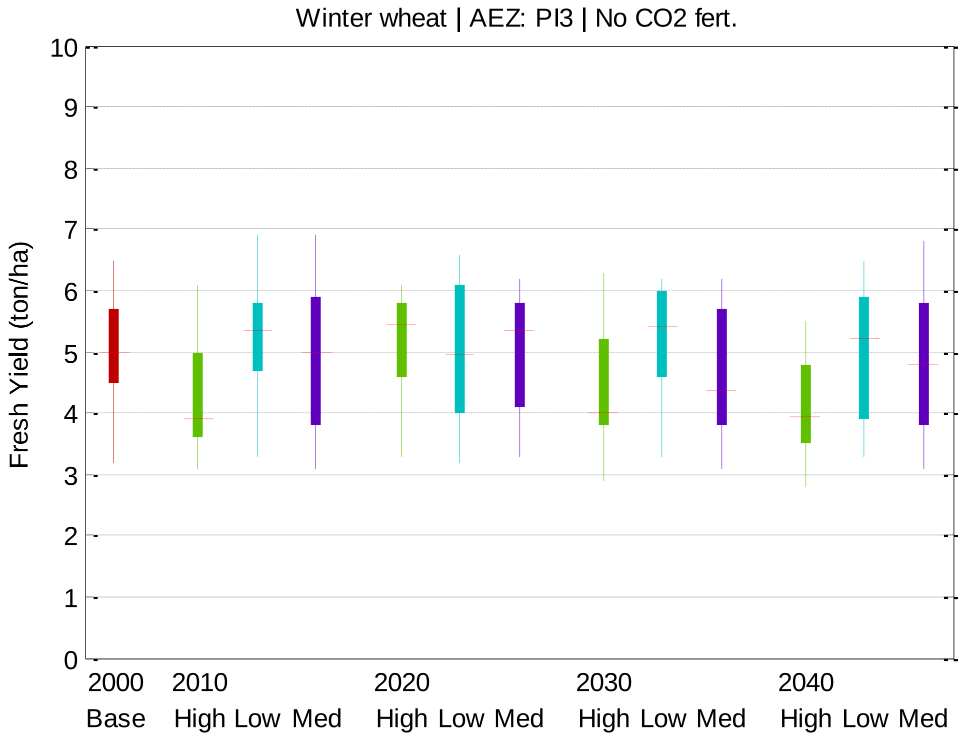

Table 1-9. Yield Statistics for Winter wheat, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	5.0	3.2	6.5	1.1
2010	High	4.3	3.1	6.1	1.0
2010	Low	5.2	3.3	6.9	1.2
2010	Med	4.9	3.1	6.9	1.3
2020	High	5.1	3.3	6.1	1.0
2020	Low	5.0	3.2	6.6	1.2
2020	Med	5.0	3.3	6.2	1.1
2030	High	4.3	2.9	6.3	1.2
2030	Low	5.1	3.3	6.2	1.1
2030	Med	4.6	3.1	6.2	1.1
2040	High	4.0	2.8	5.5	0.9
2040	Low	5.0	3.3	6.5	1.1
2040	Med	4.8	3.1	6.8	1.2

Figure 1-10. Yields for Winter wheat, AEZ: PI3 | CO2 fert.

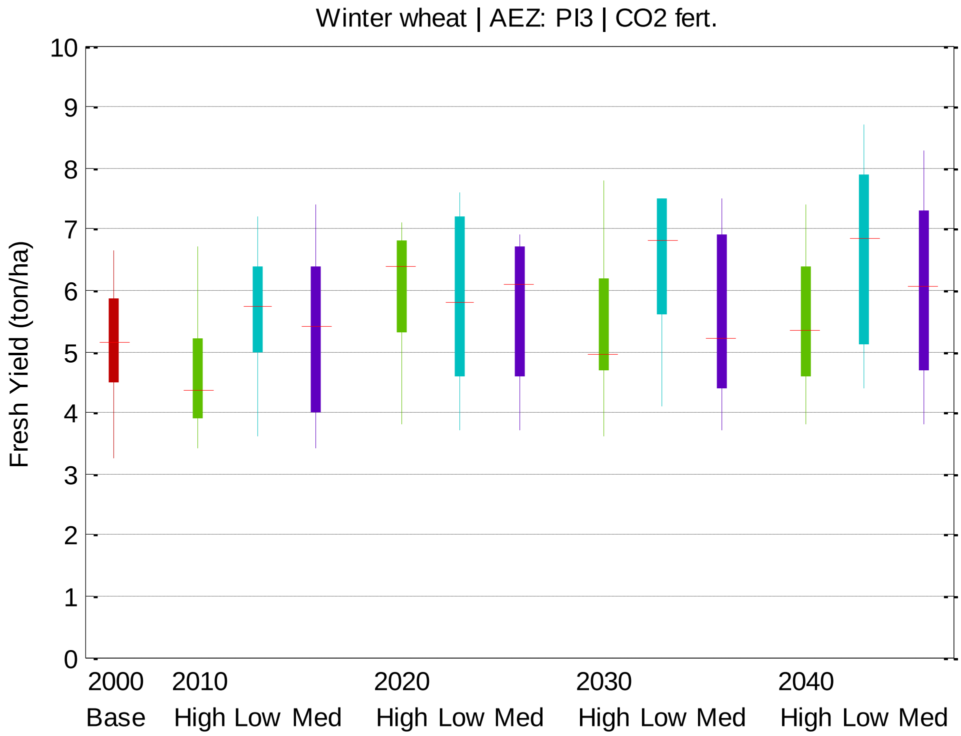

Table 1-10. Yield Statistics for Winter wheat, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	Min	Max	StDev
2000	Base	5.1	3.2	6.7	1.2
2010	High	4.6	3.4	6.7	1.1
2010	Low	5.6	3.6	7.2	1.2
2010	Med	5.3	3.4	7.4	1.4
2020	High	5.9	3.8	7.1	1.2
2020	Low	5.8	3.7	7.6	1.4
2020	Med	5.7	3.7	6.9	1.2
2030	High	5.4	3.6	7.8	1.4
2030	Low	6.4	4.1	7.5	1.3
2030	Med	5.5	3.7	7.5	1.3
2040	High	5.4	3.8	7.4	1.2
2040	Low	6.7	4.4	8.7	1.5
2040	Med	6.0	3.8	8.3	1.5

B. Appendix - Impact on Crop Irrigation Water Requirements

B.1 **Alfalfa**

Figure 1-1. IWR for Alfalfa, AEZ: DS2 | No CO2 fert.

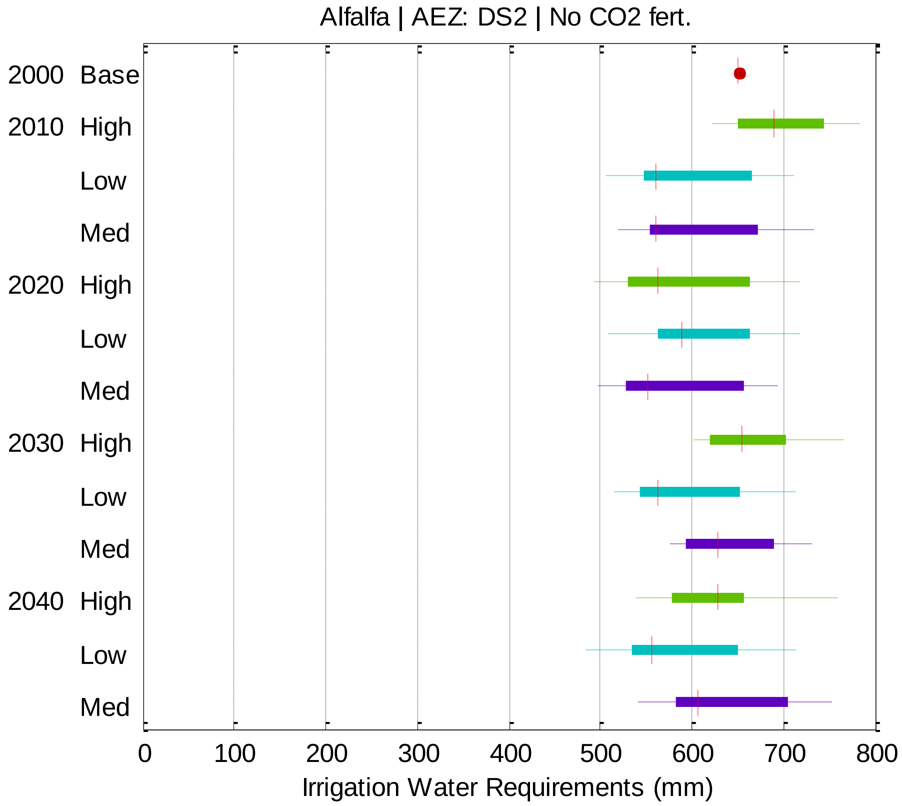

Table 1-1. IWR Statistics for Alfalfa, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	694.2	53.9
2010	Low	593.6	72.2
2010	Med	602.2	77.3
2020	High	590.1	81.6
2020	Low	604.6	71.3
2020	Med	584.0	74.9
2030	High	667.8	58.4
2030	Low	595.6	75.1
2030	Med	639.1	56.5
2040	High	632.8	72.2
2040	Low	585.1	83.1
2040	Med	635.9	72.5

Figure 1-2. IWR for Alfalfa, AEZ: DS2 | CO2 fert.

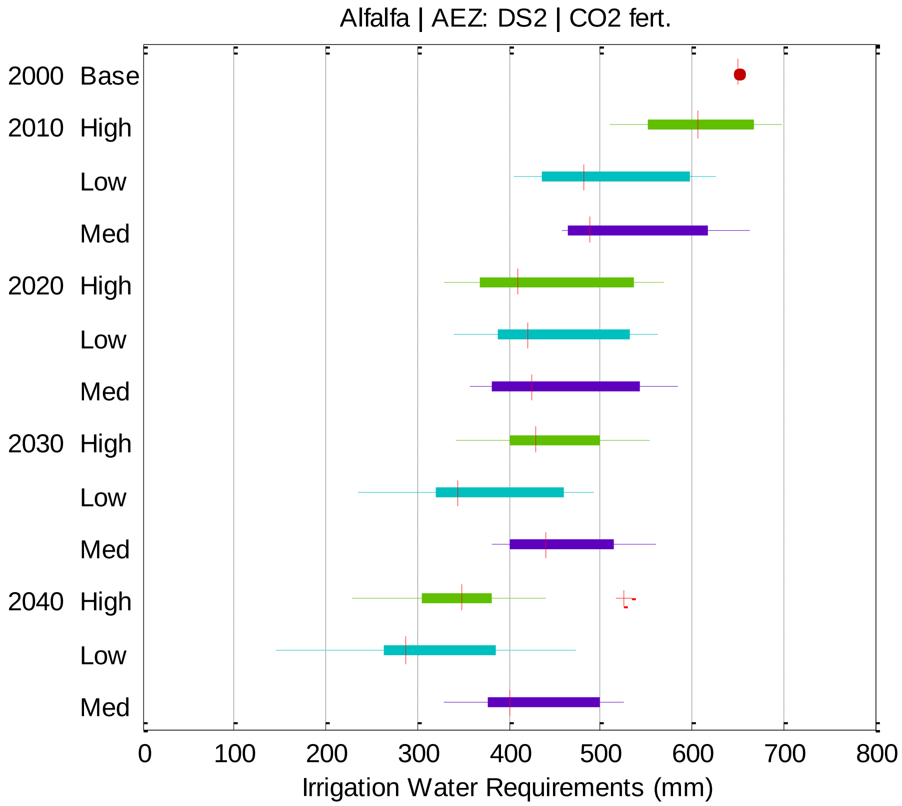

Table 1-2. IWR Statistics for Alfalfa, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	606.6	60.7
2010	Low	504.7	79.7
2010	Med	528.7	82.4
2020	High	431.5	90.5
2020	Low	445.8	82.0
2020	Med	454.5	84.3
2030	High	445.9	70.9
2030	Low	365.2	86.5
2030	Med	459.1	63.4
2040	High	354.0	87.5
2040	Low	308.8	104.5
2040	Med	421.5	69.3

Figure 1-3. IWR for Alfalfa, AEZ: DS5 | No CO2 fert.

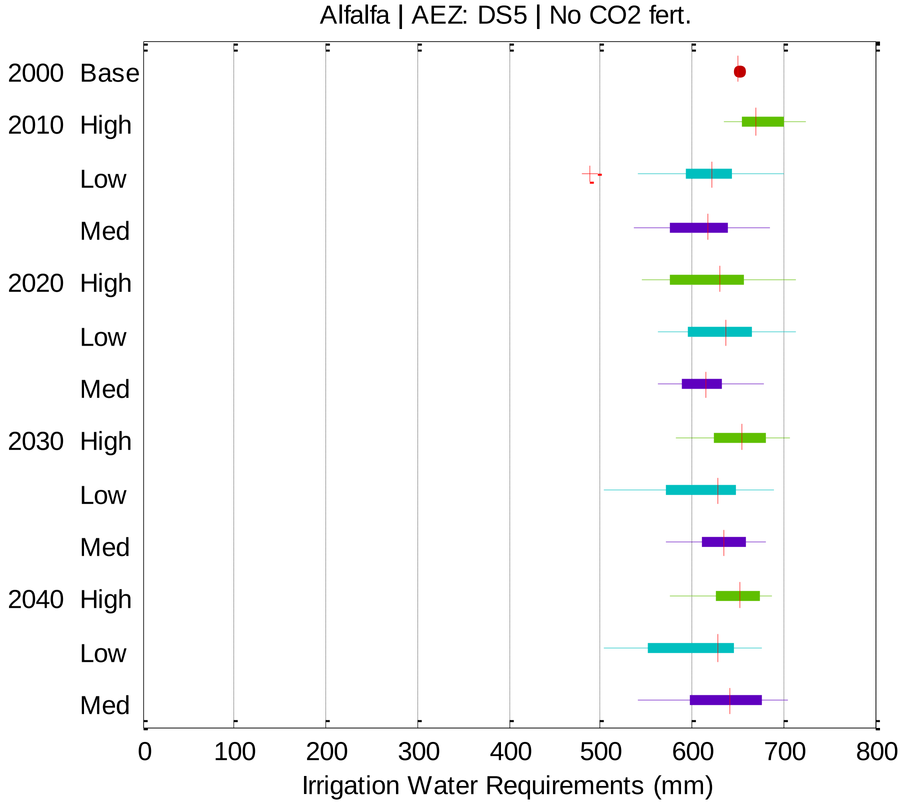

Table 1-3. IWR Statistics for Alfalfa, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	674.7	31.2
2010	Low	612.7	62.2
2010	Med	611.0	50.2
2020	High	627.6	54.4
2020	Low	634.6	49.5
2020	Med	615.7	37.9
2030	High	651.3	37.2
2030	Low	617.9	57.6
2030	Med	630.8	37.3
2040	High	643.0	37.2
2040	Low	607.0	57.8
2040	Med	634.8	55.0

Figure 1-4. IWR for Alfalfa, AEZ: DS5 | CO2 fert.

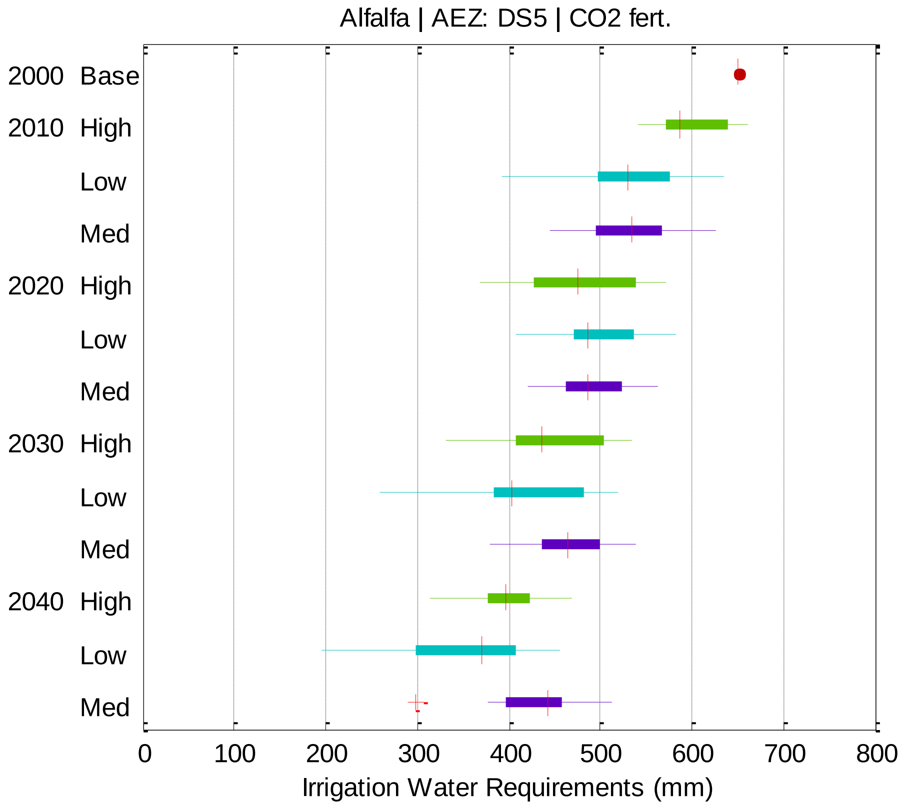

Table 1-4. IWR Statistics for Alfalfa, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	595.3	41.3
2010	Low	534.7	70.3
2010	Med	537.2	57.0
2020	High	479.9	66.5
2020	Low	493.8	53.7
2020	Med	495.3	46.1
2030	High	444.4	63.4
2030	Low	416.4	75.8
2030	Med	466.5	48.2
2040	High	395.6	46.2
2040	Low	353.7	77.5
2040	Med	428.7	61.7

Figure 1-5. IWR for Alfalfa, AEZ: HI3 | No CO2 fert.

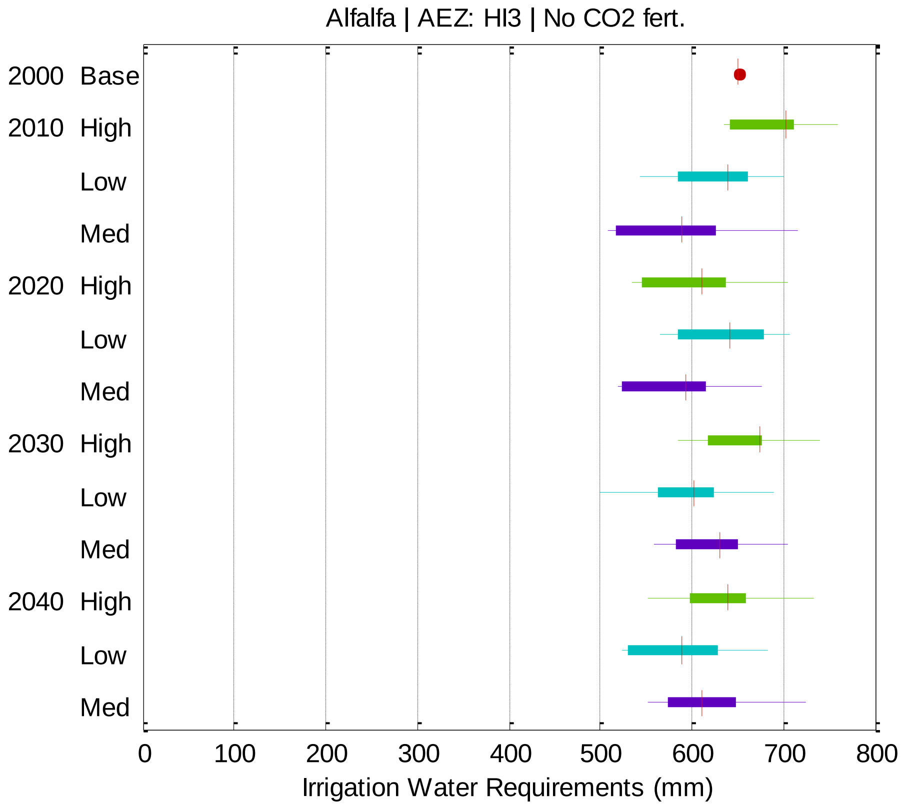

Table 1-5. IWR Statistics for Alfalfa, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	689.0	42.4
2010	Low	622.1	53.9
2010	Med	589.5	69.8
2020	High	603.8	59.3
2020	Low	634.9	49.3
2020	Med	582.6	55.8
2030	High	658.6	48.4
2030	Low	594.3	59.9
2030	Med	623.3	47.6
2040	High	635.5	53.4
2040	Low	586.2	57.2
2040	Med	622.7	60.0

Figure 1-6. IWR for Alfalfa, AEZ: HI3 | CO2 fert.

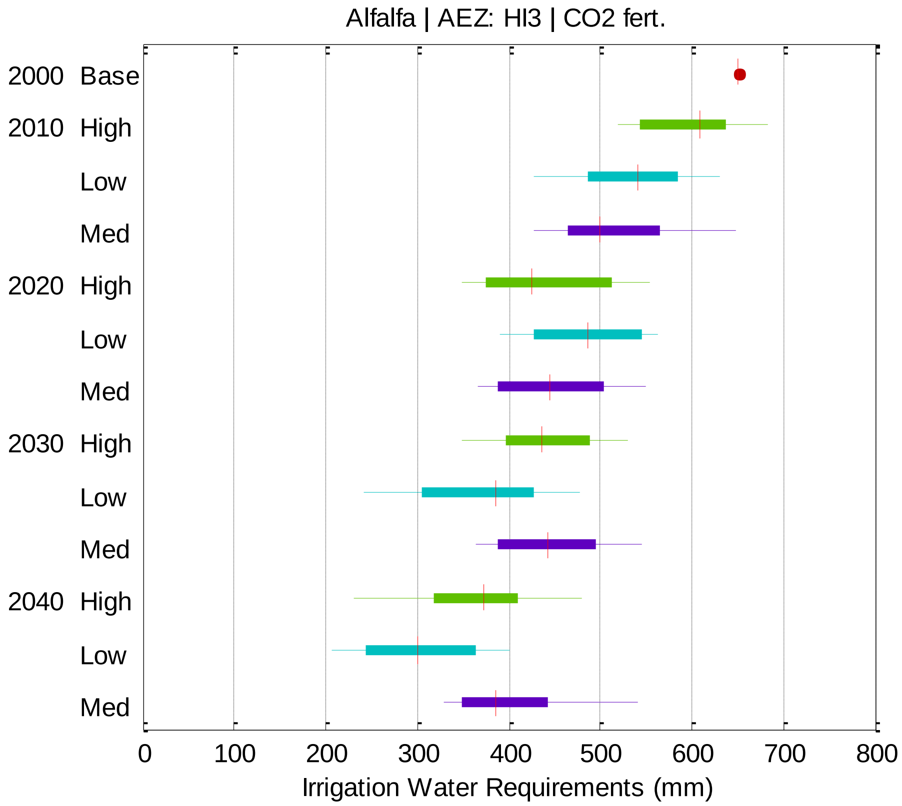

Table 1-6. IWR Statistics for Alfalfa, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	601.1	53.2
2010	Low	538.3	67.3
2010	Med	516.4	75.2
2020	High	443.3	73.1
2020	Low	484.8	65.1
2020	Med	452.0	65.4
2030	High	437.8	61.5
2030	Low	377.9	77.1
2030	Med	448.2	62.9
2040	High	365.3	69.9
2040	Low	302.4	65.0
2040	Med	404.8	74.6

Figure 1-7. IWR for Alfalfa, AEZ: PI1 | No CO2 fert.

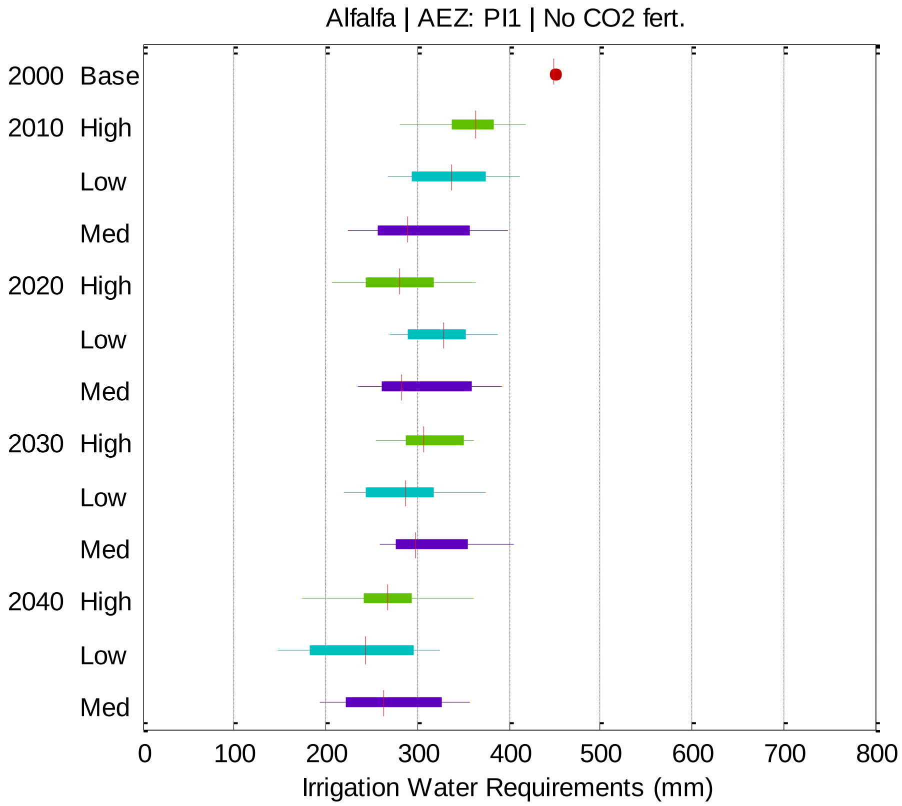

Table 1-7. IWR Statistics for Alfalfa, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	450.0	0.0
2010	High	356.2	41.3
2010	Low	337.4	44.7
2010	Med	303.1	59.0
2020	High	282.9	49.9
2020	Low	326.4	39.1
2020	Med	304.6	57.2
2030	High	313.9	38.8
2030	Low	288.8	47.1
2030	Med	316.6	50.6
2040	High	264.3	53.1
2040	Low	238.4	61.8
2040	Med	273.4	58.7

Figure 1-8. IWR for Alfalfa, AEZ: PI1 | CO2 fert.

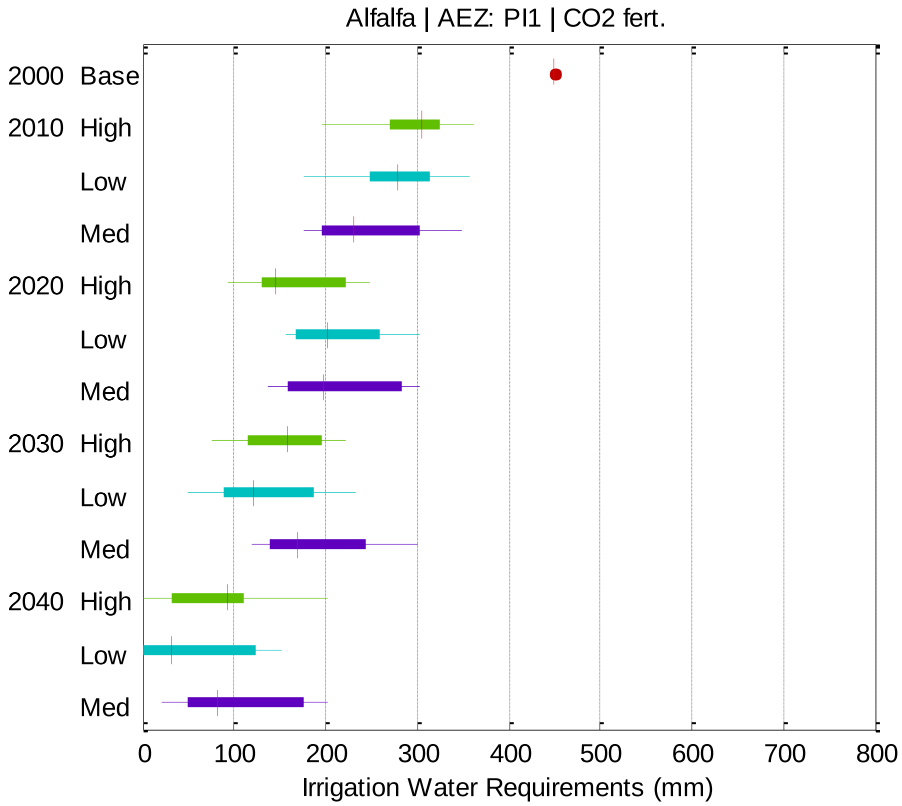

Table 1-8. IWR Statistics for Alfalfa, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	450.0	0.0
2010	High	294.7	50.9
2010	Low	276.7	53.3
2010	Med	250.3	61.8
2020	High	162.2	57.5
2020	Low	216.2	51.3
2020	Med	212.7	63.2
2030	High	152.1	51.2
2030	Low	132.3	55.6
2030	Med	188.4	62.8
2040	High	83.1	63.5
2040	Low	53.4	62.6
2040	Med	108.2	66.1

Figure 1-9. IWR for Alfalfa, AEZ: PI3 | No CO2 fert.

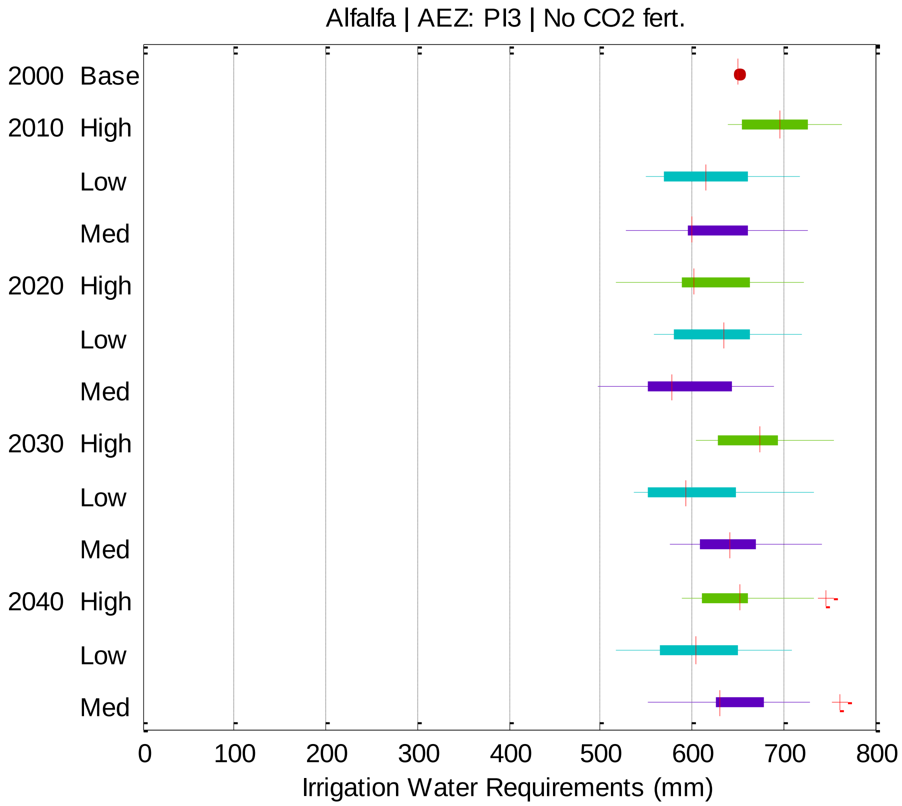

Table 1-9. IWR Statistics for Alfalfa, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	696.7	44.0
2010	Low	625.6	57.6
2010	Med	618.5	65.2
2020	High	613.5	69.7
2020	Low	634.2	54.5
2020	Med	591.0	65.6
2030	High	675.0	51.8
2030	Low	609.2	66.8
2030	Med	648.9	53.4
2040	High	655.0	51.9
2040	Low	607.6	62.8
2040	Med	647.5	63.3

Figure 1-10. IWR for Alfalfa, AEZ: PI3 | CO2 fert.

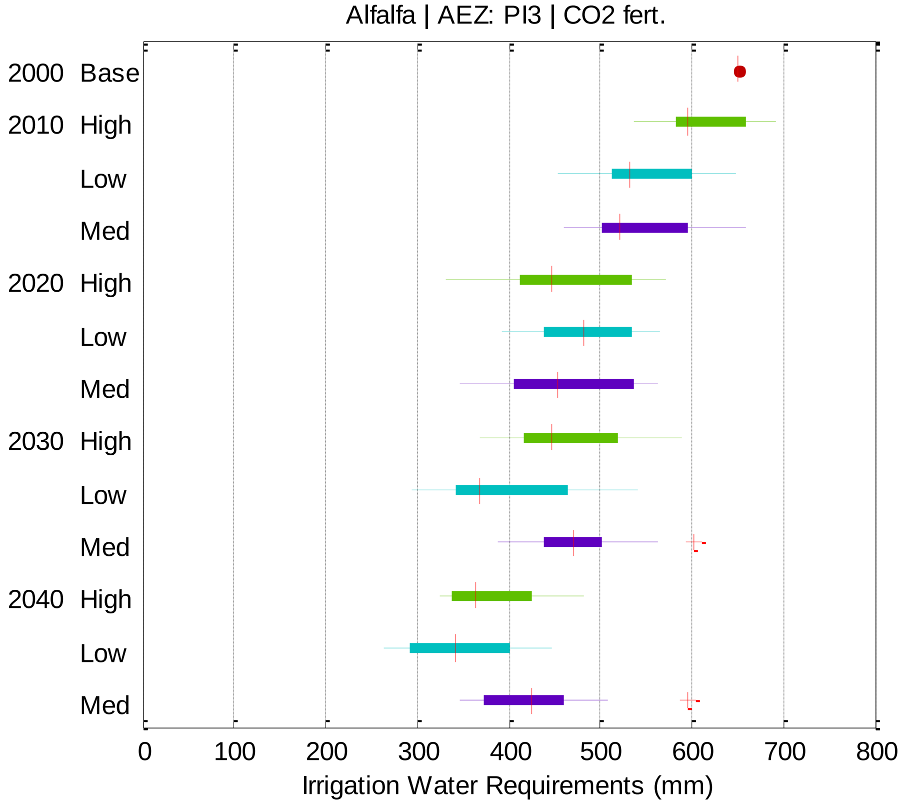

Table 1-10. IWR Statistics for Alfalfa, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	650.0	0.0
2010	High	610.4	53.3
2010	Low	542.9	66.5
2010	Med	543.1	68.1
2020	High	460.5	78.5
2020	Low	479.7	62.7
2020	Med	460.2	69.5
2030	High	465.3	71.3
2030	Low	391.0	80.0
2030	Med	482.6	63.1
2040	High	386.9	60.4
2040	Low	344.9	60.6
2040	Med	433.2	76.0

B.2 Apples

Figure 1-11. IWR for Apples, AEZ: DS2 | No CO2 fert.

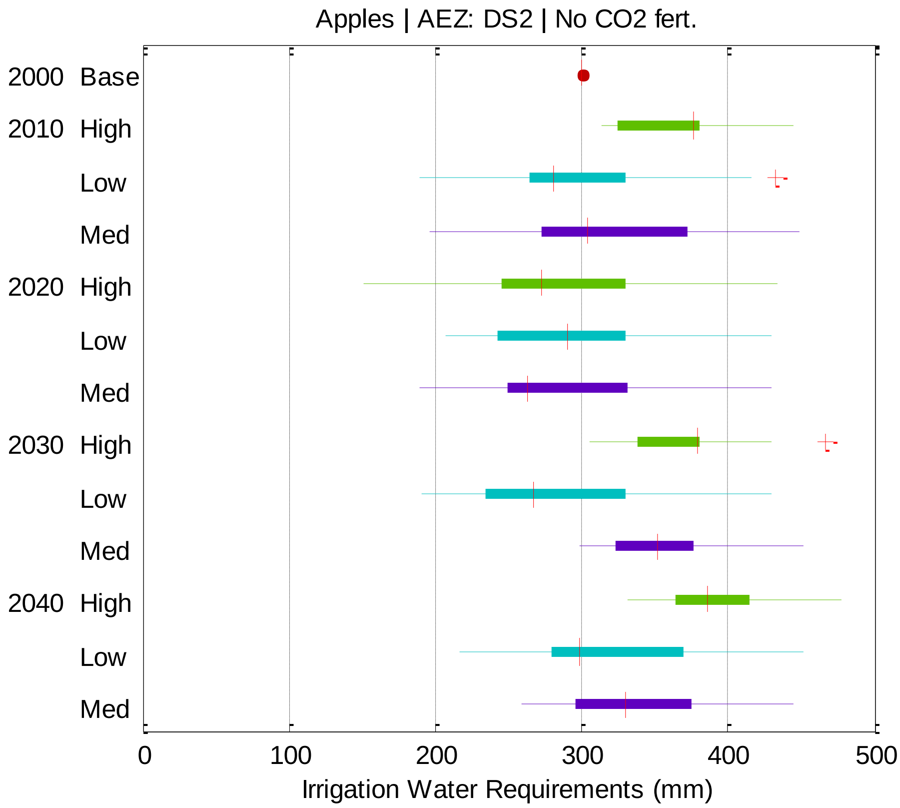

Table 1-11. IWR Statistics for Apples, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	368.5	43.1
2010	Low	302.8	76.4
2010	Med	319.7	76.9
2020	High	289.7	86.7
2020	Low	302.5	75.3
2020	Med	294.6	80.1
2030	High	372.6	48.6
2030	Low	294.7	78.8
2030	Med	357.7	49.1
2040	High	395.3	44.4
2040	Low	320.9	75.5
2040	Med	337.3	61.5

Figure 1-12. IWR for Apples, AEZ: DS2 | CO2 fert.

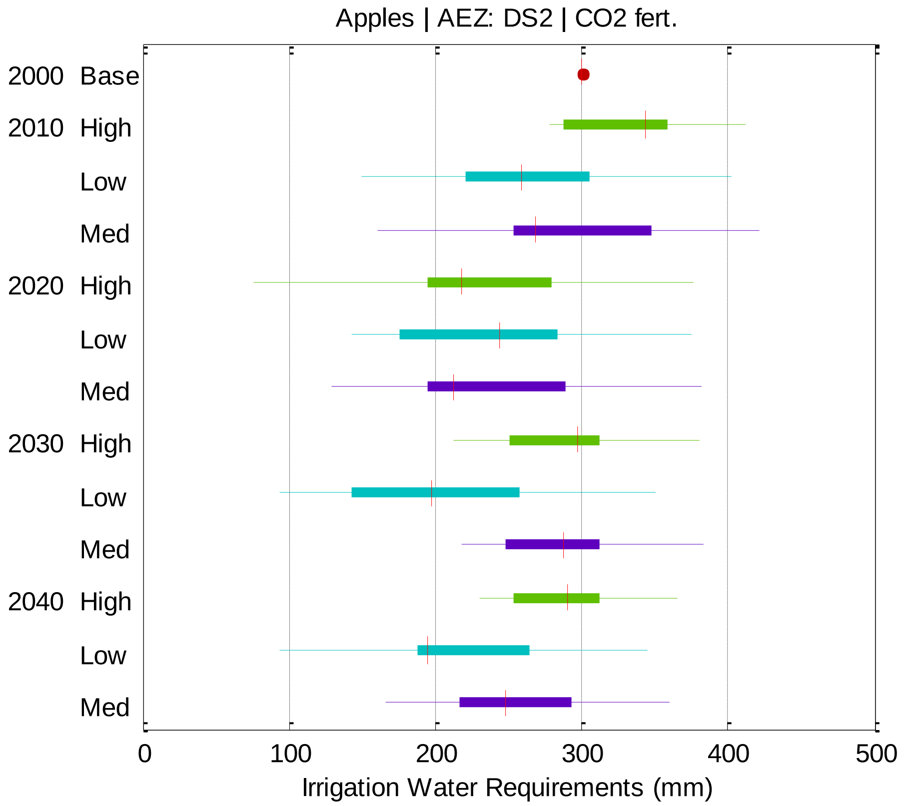

Table 1-12. IWR Statistics for Apples, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	335.9	47.3
2010	Low	271.1	79.4
2010	Med	291.0	78.1
2020	High	229.9	90.9
2020	Low	245.6	79.2
2020	Med	244.0	83.0
2030	High	288.9	52.7
2030	Low	211.1	83.8
2030	Med	289.1	52.9
2040	High	292.0	42.4
2040	Low	215.2	79.1
2040	Med	253.4	62.8

Figure 1-13. IWR for Apples, AEZ: DS5 | No CO2 fert.

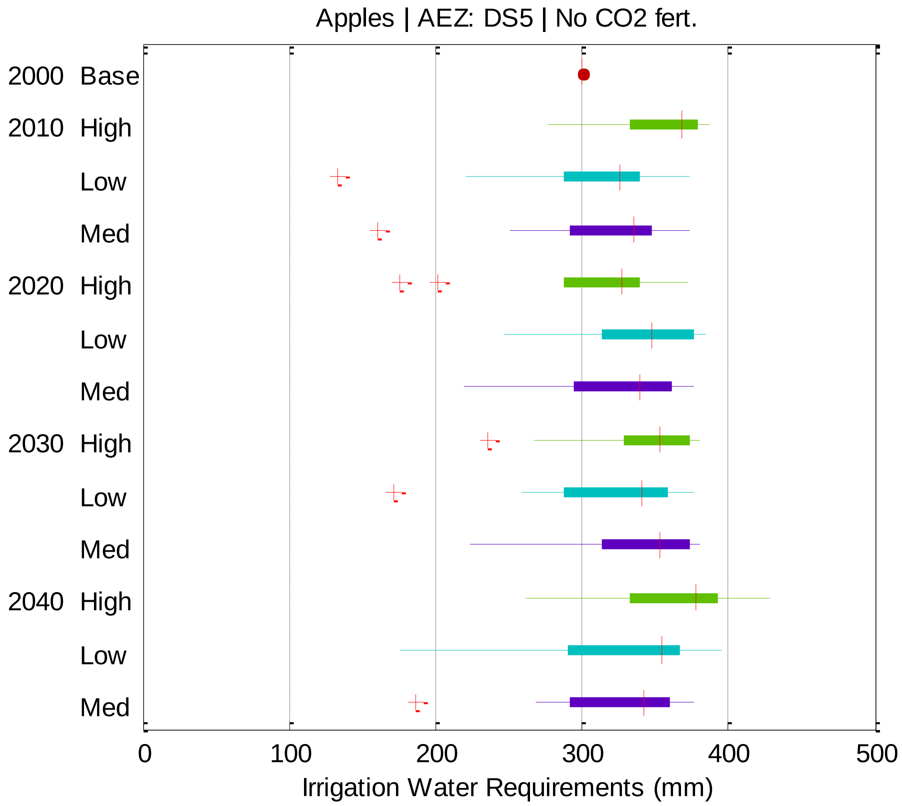

Table 1-13. IWR Statistics for Apples, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	351.7	39.1
2010	Low	300.8	71.8
2010	Med	312.3	64.1
2020	High	303.5	64.4
2020	Low	335.2	51.8
2020	Med	324.5	50.4
2030	High	337.2	49.9
2030	Low	317.4	62.1
2030	Med	334.4	53.6
2040	High	362.6	49.9
2040	Low	327.5	69.0
2040	Med	322.4	58.7

Figure 1-14. IWR for Apples, AEZ: DS5 | CO2 fert.

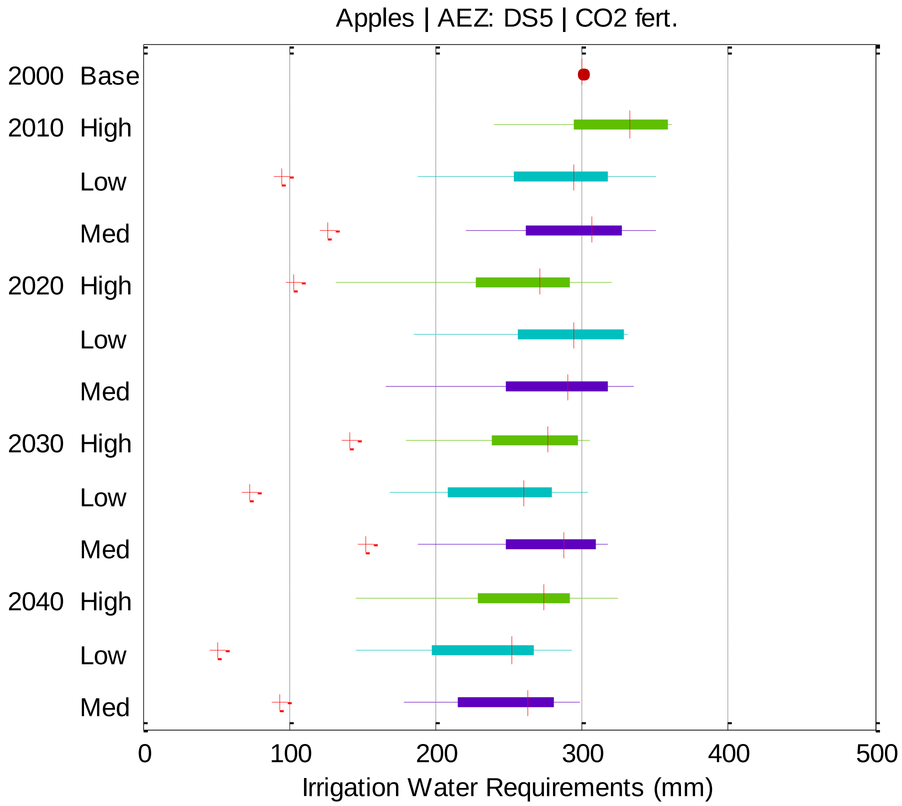

Table 1-14. IWR Statistics for Apples, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	319.1	42.6
2010	Low	270.4	75.8
2010	Med	284.5	67.4
2020	High	245.0	71.8
2020	Low	280.6	55.6
2020	Med	277.6	53.9
2030	High	254.6	55.1
2030	Low	235.5	69.6
2030	Med	267.7	56.0
2040	High	256.7	53.2
2040	Low	224.4	74.3
2040	Med	240.9	63.2

Figure 1-15. IWR for Apples, AEZ: HI3 | No CO2 fert.

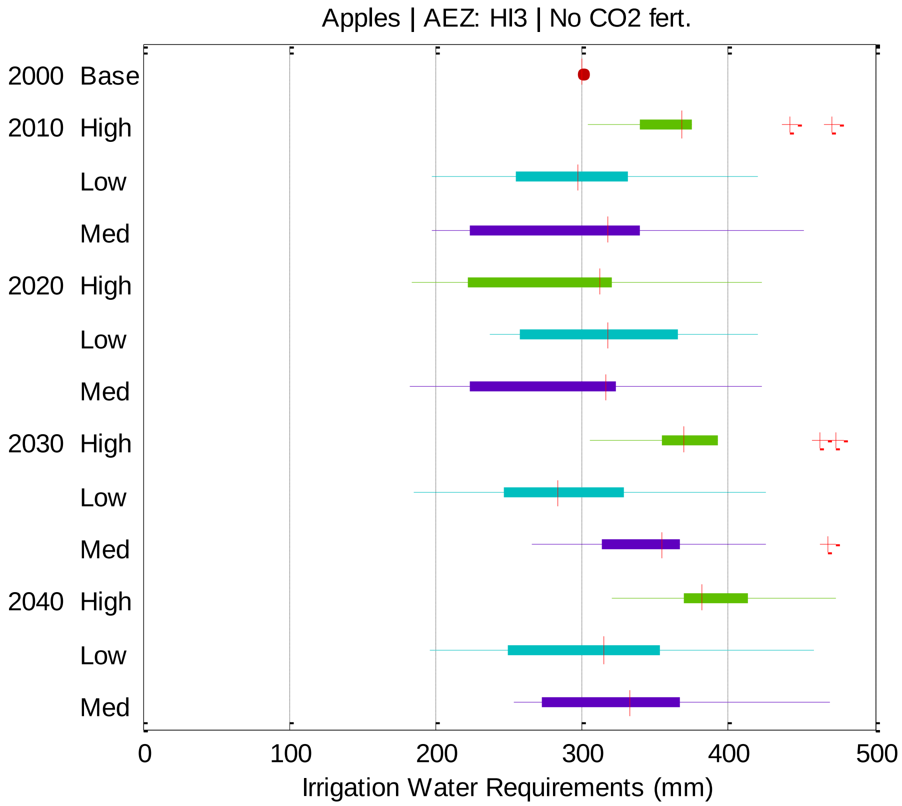

Table 1-15. IWR Statistics for Apples, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	371.2	52.3
2010	Low	299.6	76.4
2010	Med	303.1	88.2
2020	High	295.8	83.4
2020	Low	321.4	63.7
2020	Med	295.3	84.0
2030	High	379.5	54.8
2030	Low	292.6	79.5
2030	Med	351.0	62.0
2040	High	391.1	49.9
2040	Low	311.1	81.5
2040	Med	341.6	75.3

Figure 1-16. IWR for Apples, AEZ: HI3 | CO2 fert.

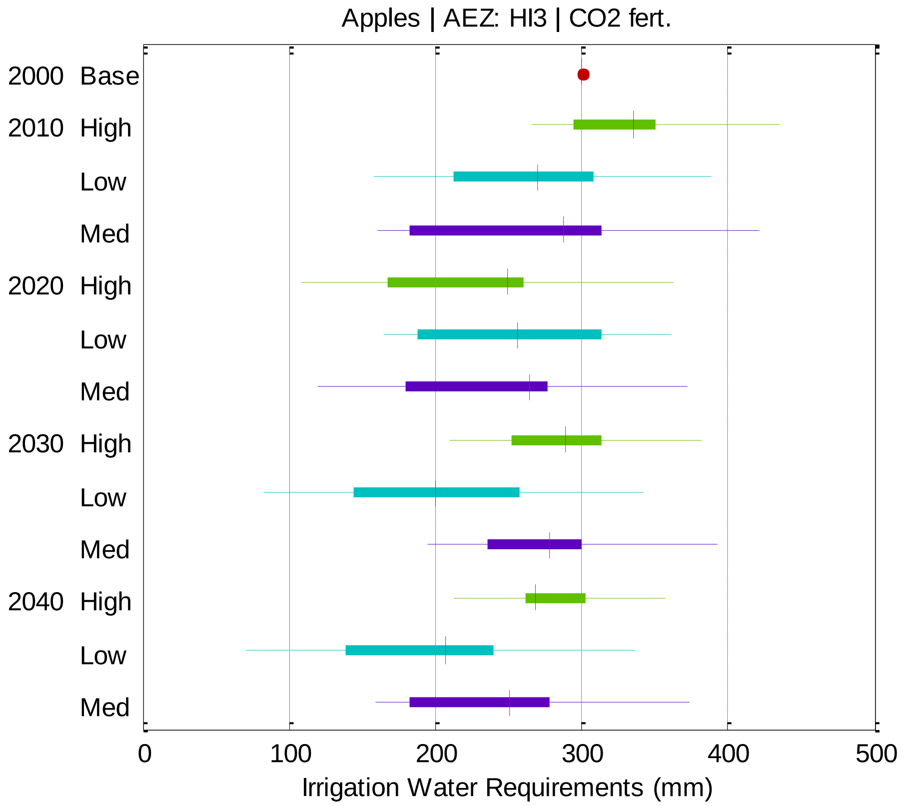

Table 1-16. IWR Statistics for Apples, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	336.5	55.3
2010	Low	266.4	79.9
2010	Med	271.8	90.7
2020	High	231.7	87.8
2020	Low	259.8	69.3
2020	Med	241.5	88.0
2030	High	289.8	56.2
2030	Low	203.7	86.9
2030	Med	278.7	62.3
2040	High	279.9	47.1
2040	Low	196.1	84.8
2040	Med	251.8	75.5

Figure 1-17. IWR for Apples, AEZ: PI1 | No CO2 fert.

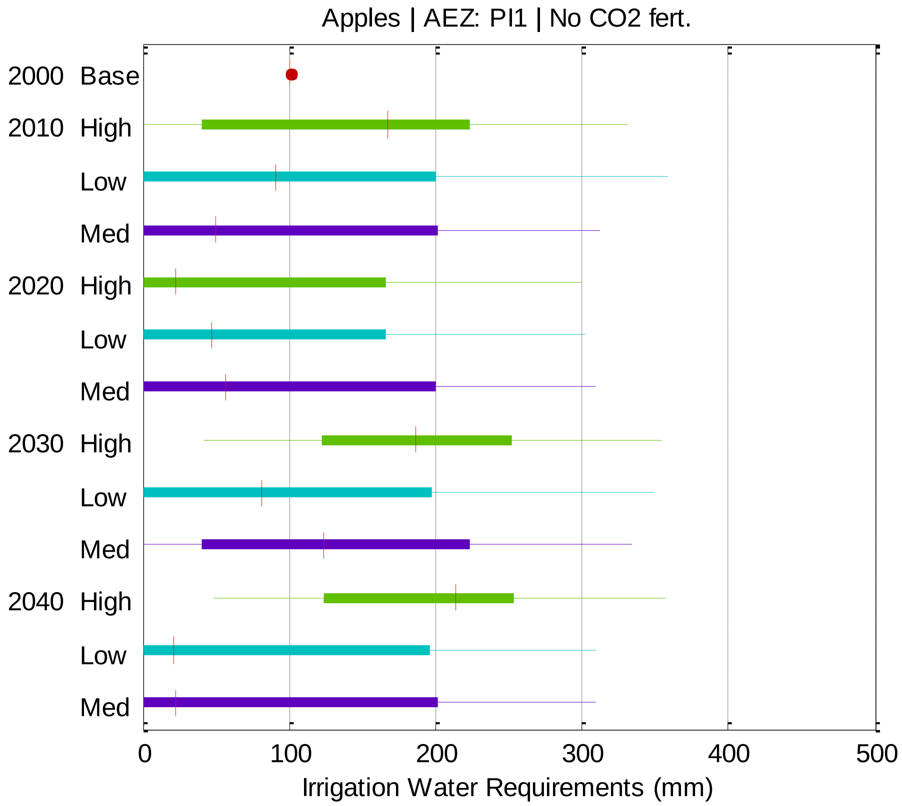

Table 1-17. IWR Statistics for Apples, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	100.0	0.0
2010	High	159.6	114.3
2010	Low	122.4	131.0
2010	Med	107.3	129.5
2020	High	95.6	124.5
2020	Low	97.1	117.0
2020	Med	105.2	123.1
2030	High	190.2	98.6
2030	Low	117.6	131.2
2030	Med	144.1	120.6
2040	High	211.2	99.5
2040	Low	92.4	121.5
2040	Med	99.3	127.2

Figure 1-18. IWR for Apples, AEZ: PI1 | CO2 fert.

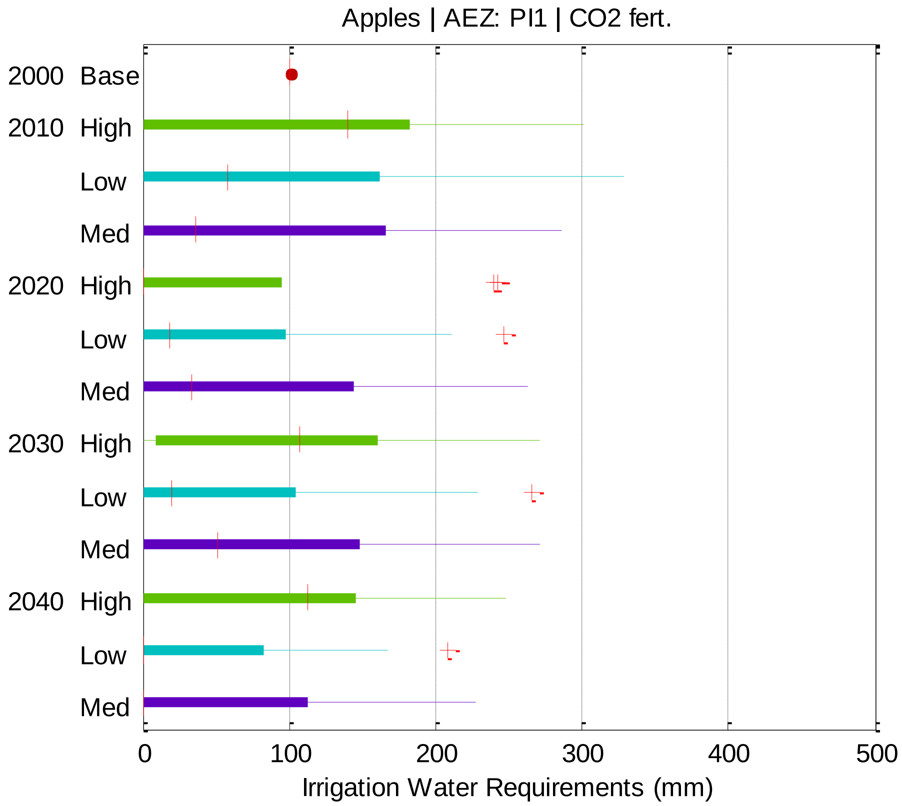

Table 1-18. IWR Statistics for Apples, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	100.0	0.0
2010	High	128.9	113.4
2010	Low	100.2	123.2
2010	Med	93.4	117.0
2020	High	66.6	99.3
2020	Low	68.5	93.2
2020	Med	82.1	102.0
2030	High	108.3	97.7
2030	Low	69.5	100.2
2030	Med	90.5	105.0
2040	High	106.7	93.3
2040	Low	45.8	79.7
2040	Med	61.5	91.5

Figure 1-19. IWR for Apples, AEZ: PI3 | No CO2 fert.

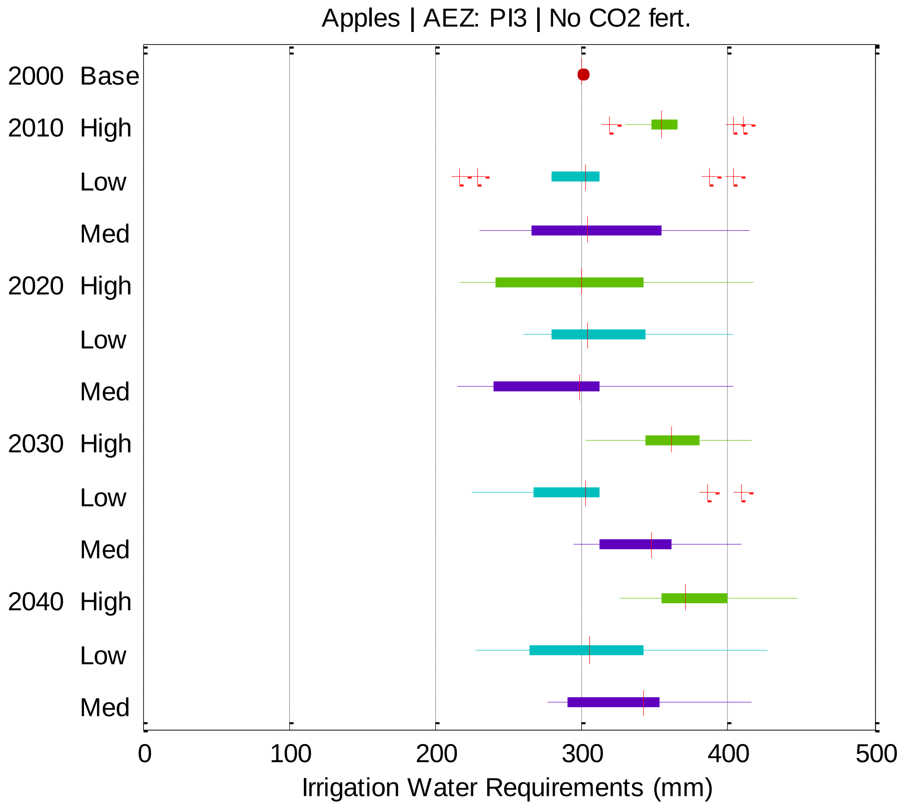

Table 1-19. IWR Statistics for Apples, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	359.1	28.6
2010	Low	303.7	58.5
2010	Med	316.8	61.4
2020	High	305.4	68.5
2020	Low	317.7	48.5
2020	Med	297.7	62.5
2030	High	364.9	33.9
2030	Low	303.7	58.2
2030	Med	348.0	38.1
2040	High	378.8	37.2
2040	Low	315.0	60.9
2040	Med	337.5	48.5

Figure 1-20. IWR for Apples, AEZ: PI3 | CO2 fert.

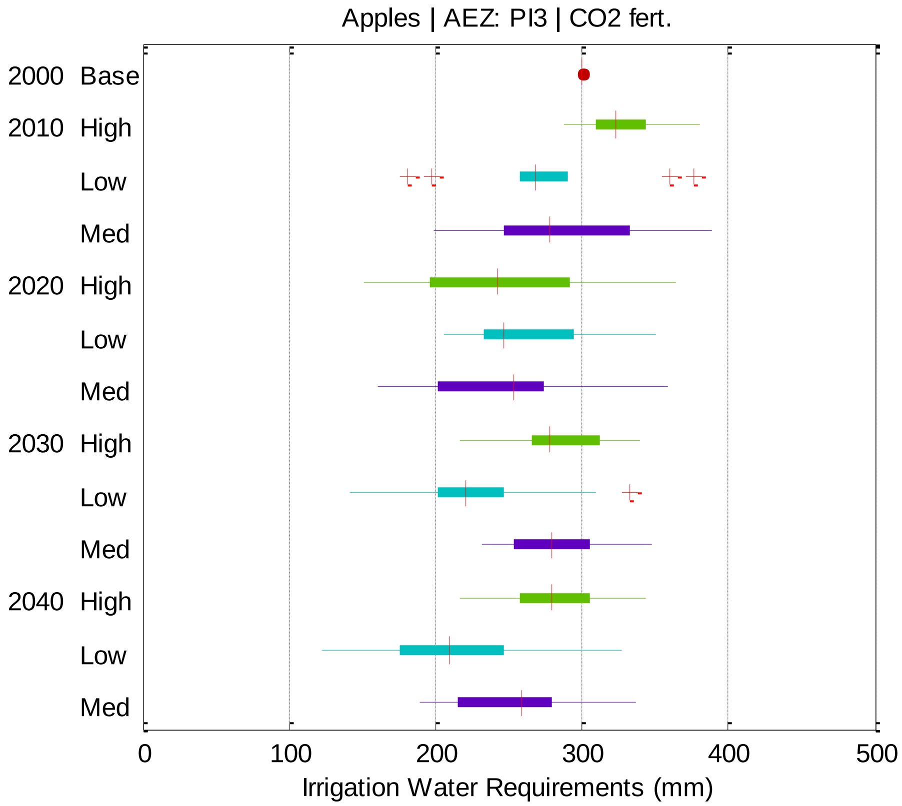

Table 1-20. IWR Statistics for Apples, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	328.8	30.9
2010	Low	274.3	60.7
2010	Med	290.2	62.0
2020	High	250.5	70.6
2020	Low	265.4	49.6
2020	Med	251.3	64.2
2030	High	286.6	36.9
2030	Low	228.2	60.1
2030	Med	285.0	39.2
2040	High	280.9	36.4
2040	Low	219.1	61.3
2040	Med	256.9	49.7

B.3 Cotton

Figure 1-21. IWR for Cotton, AEZ: DS2 | No CO2 fert.

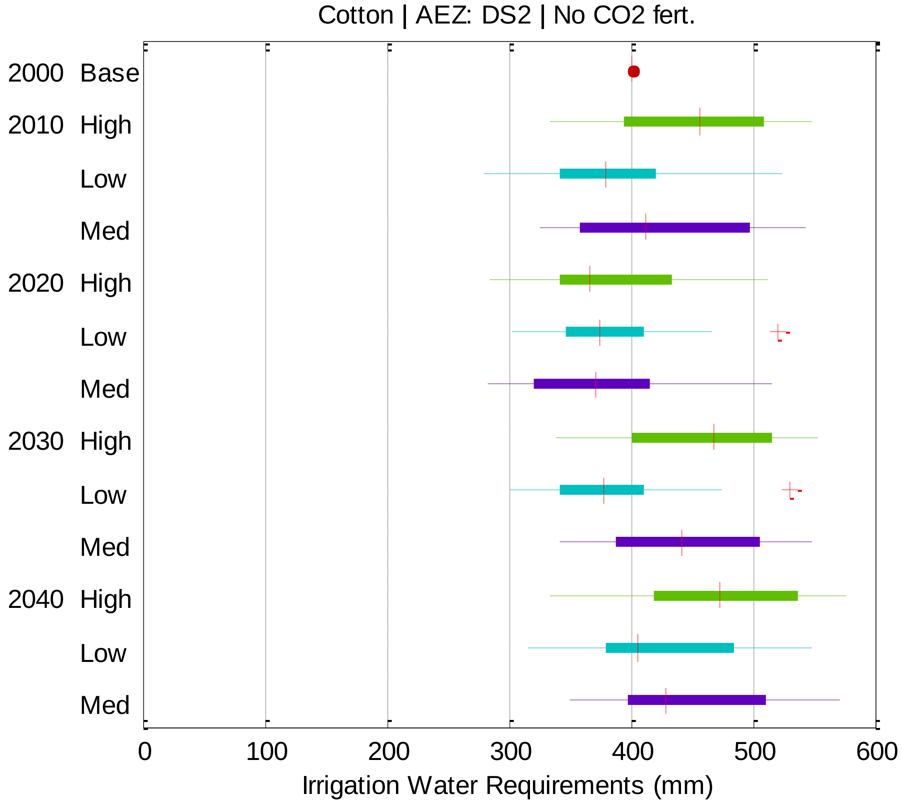

Table 1-21. IWR Statistics for Cotton, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	400.0	0.0
2010	High	451.2	71.4
2010	Low	388.7	79.6
2010	Med	424.7	80.0
2020	High	382.1	70.3
2020	Low	388.2	65.1
2020	Med	378.1	71.9
2030	High	459.0	70.2
2030	Low	390.3	69.4
2030	Med	442.5	69.1
2040	High	473.7	74.1
2040	Low	425.4	76.2
2040	Med	448.6	72.6

Figure 1-22. IWR for Cotton, AEZ: DS2 | CO2 fert.

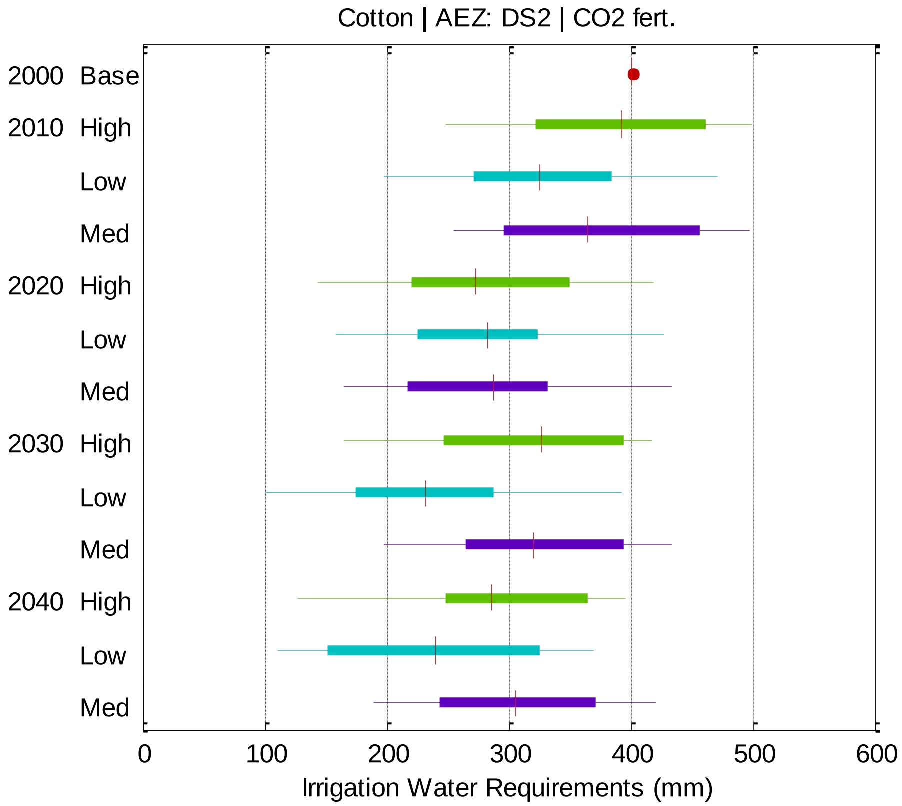

Table 1-22. IWR Statistics for Cotton, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	400.0	0.0
2010	High	393.0	82.2
2010	Low	332.9	90.4
2010	Med	373.0	87.6
2020	High	276.3	86.6
2020	Low	284.1	80.8
2020	Med	288.0	85.0
2030	High	316.9	83.5
2030	Low	237.2	90.4
2030	Med	325.5	76.7
2040	High	292.0	83.2
2040	Low	239.6	93.6
2040	Med	303.1	78.1

Figure 1-23. IWR for Cotton, AEZ: DS5 | No CO2 fert.

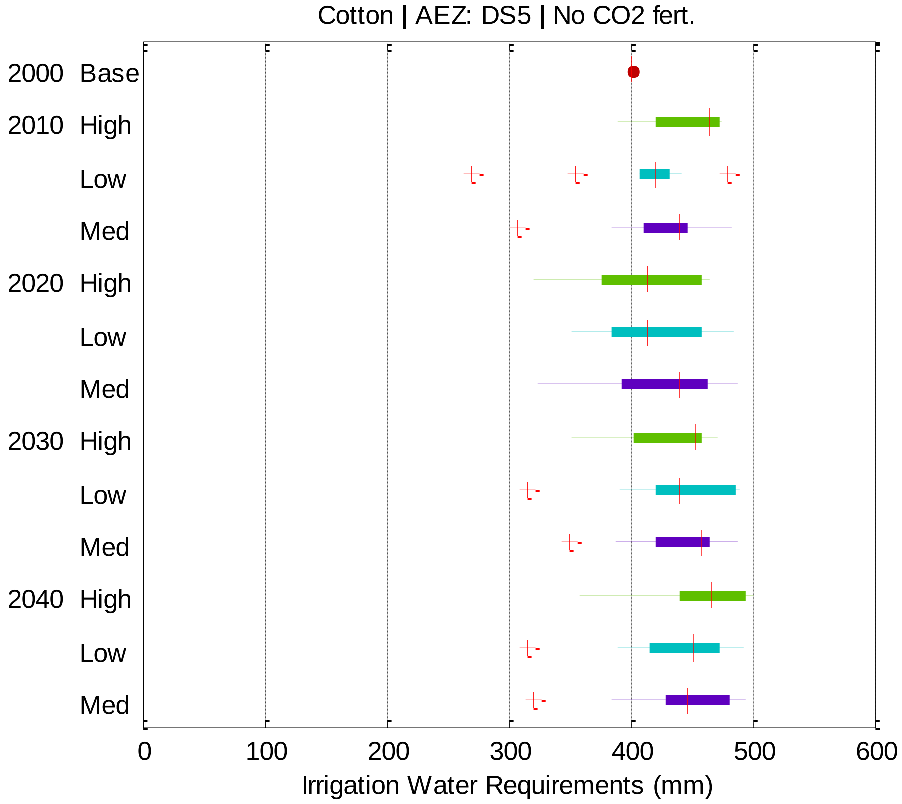

Table 1-23. IWR Statistics for Cotton, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	400.0	0.0
2010	High	448.5	34.4
2010	Low	407.7	57.5
2010	Med	424.9	50.2
2020	High	405.8	51.8
2020	Low	420.8	44.3
2020	Med	425.1	49.9
2030	High	432.3	41.1
2030	Low	438.7	54.7
2030	Med	440.3	42.4
2040	High	457.9	44.8
2040	Low	437.6	53.6
2040	Med	437.7	52.7

Figure 1-24. IWR for Cotton, AEZ: DS5 | CO2 fert.

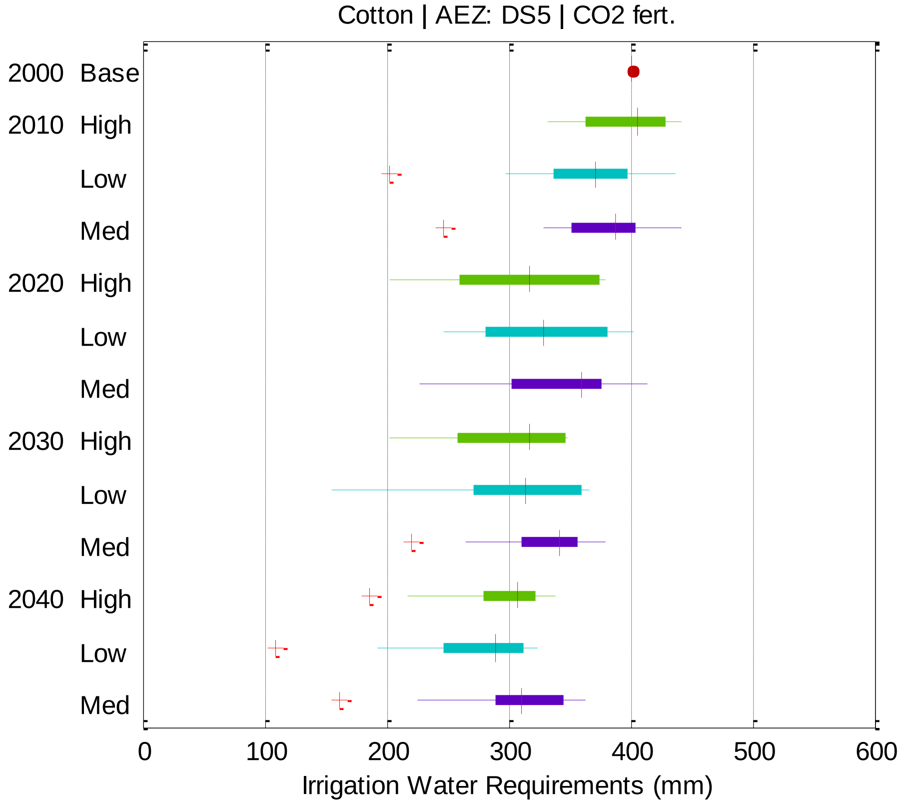

Table 1-24. IWR Statistics for Cotton, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	400.0	0.0
2010	High	395.3	41.6
2010	Low	355.5	66.4
2010	Med	377.0	58.0
2020	High	309.5	64.0
2020	Low	330.7	55.4
2020	Med	343.9	57.7
2030	High	298.6	53.7
2030	Low	302.6	68.2
2030	Med	328.3	50.2
2040	High	289.1	49.9
2040	Low	263.8	67.4
2040	Med	297.7	61.9

Figure 1-25. IWR for Cotton, AEZ: PI1 | No CO2 fert.

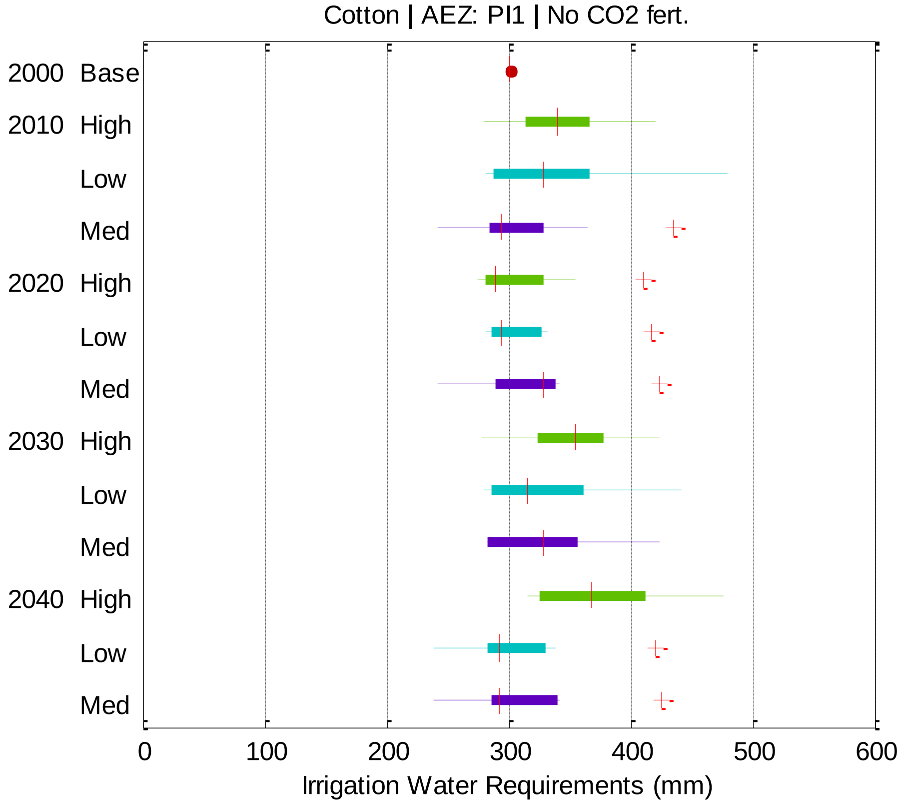

Table 1-25. IWR Statistics for Cotton, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	344.4	40.6
2010	Low	336.4	60.2
2010	Med	310.7	55.5
2020	High	309.6	44.0
2020	Low	311.5	41.5
2020	Med	320.7	48.3
2030	High	351.7	42.2
2030	Low	326.9	50.9
2030	Med	328.2	46.3
2040	High	374.1	50.3
2040	Low	307.1	50.7
2040	Med	309.1	51.9

Figure 1-26. IWR for Cotton, AEZ: PI1 | CO2 fert.

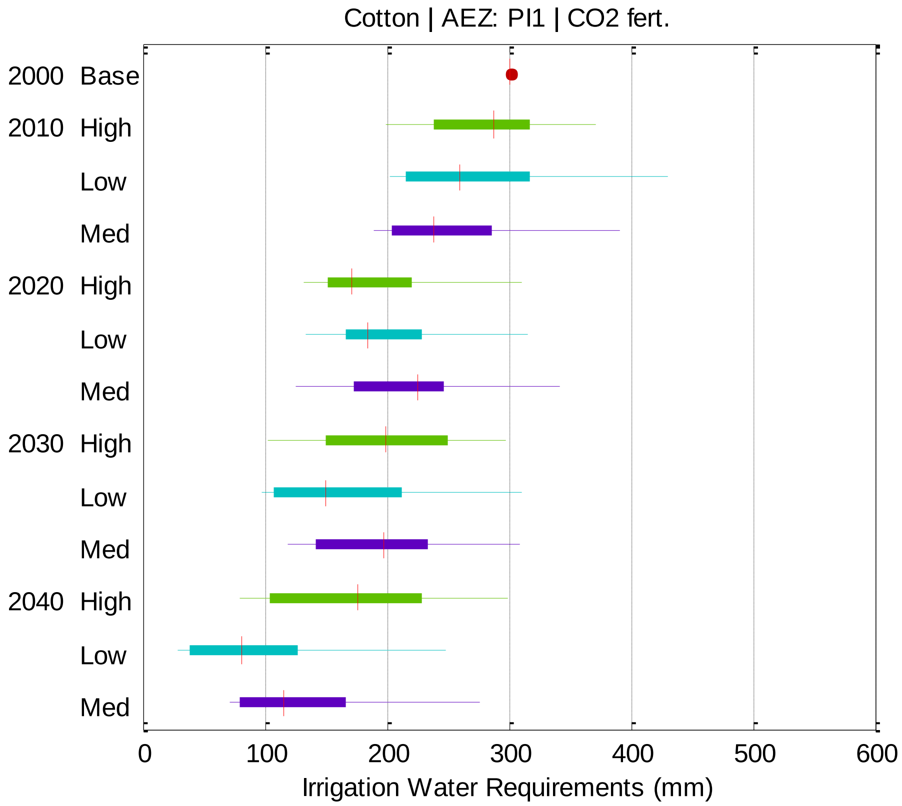

Table 1-26. IWR Statistics for Cotton, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	282.7	53.6
2010	Low	275.6	70.6
2010	Med	253.4	63.4
2020	High	190.8	57.0
2020	Low	198.2	51.8
2020	Med	221.0	60.4
2030	High	195.9	62.6
2030	Low	164.8	68.5
2030	Med	197.0	59.4
2040	High	173.6	70.4
2040	Low	95.8	69.6
2040	Med	134.7	67.1

Figure 1-27. IWR for Cotton, AEZ: PI3 | No CO2 fert.

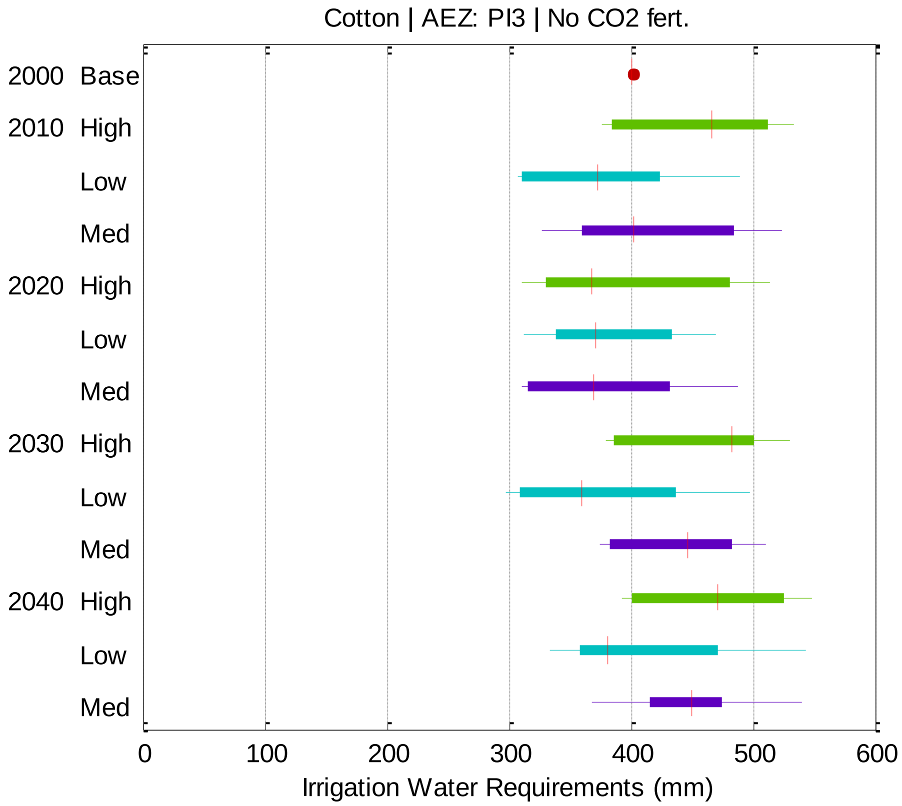

Table 1-27. IWR Statistics for Cotton, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	400.0	0.0
2010	High	455.2	60.9
2010	Low	381.6	66.0
2010	Med	419.3	71.8
2020	High	396.3	75.5
2020	Low	383.4	53.9
2020	Med	376.6	60.0
2030	High	459.4	57.5
2030	Low	378.4	70.3
2030	Med	438.9	50.6
2040	High	468.6	60.2
2040	Low	412.2	69.0
2040	Med	446.4	54.4

Figure 1-28. IWR for Cotton, AEZ: PI3 | CO2 fert.

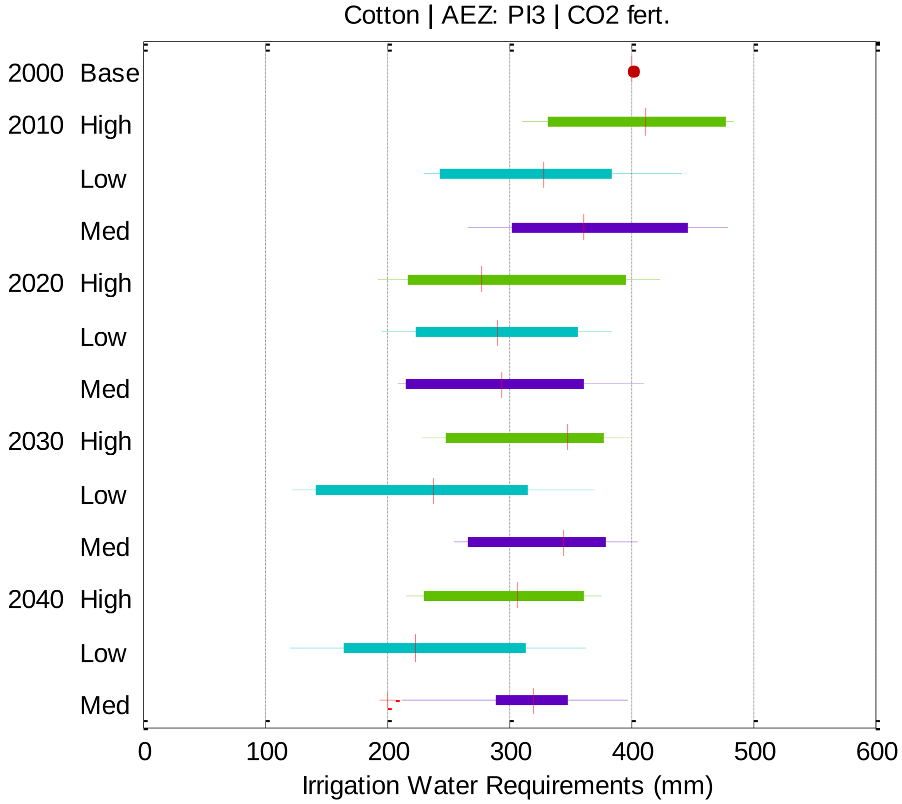

Table 1-28. IWR Statistics for Cotton, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	400.0	0.0
2010	High	403.6	69.6
2010	Low	328.8	78.4
2010	Med	372.6	78.6
2020	High	300.2	86.4
2020	Low	292.0	67.4
2020	Med	294.4	71.5
2030	High	326.2	65.4
2030	Low	239.5	89.5
2030	Med	331.7	59.6
2040	High	301.1	63.5
2040	Low	238.4	80.3
2040	Med	310.6	63.0

B.4 Potatoes

Figure 1-29. IWR for Potatoes, AEZ: DS2 | No CO2 fert.

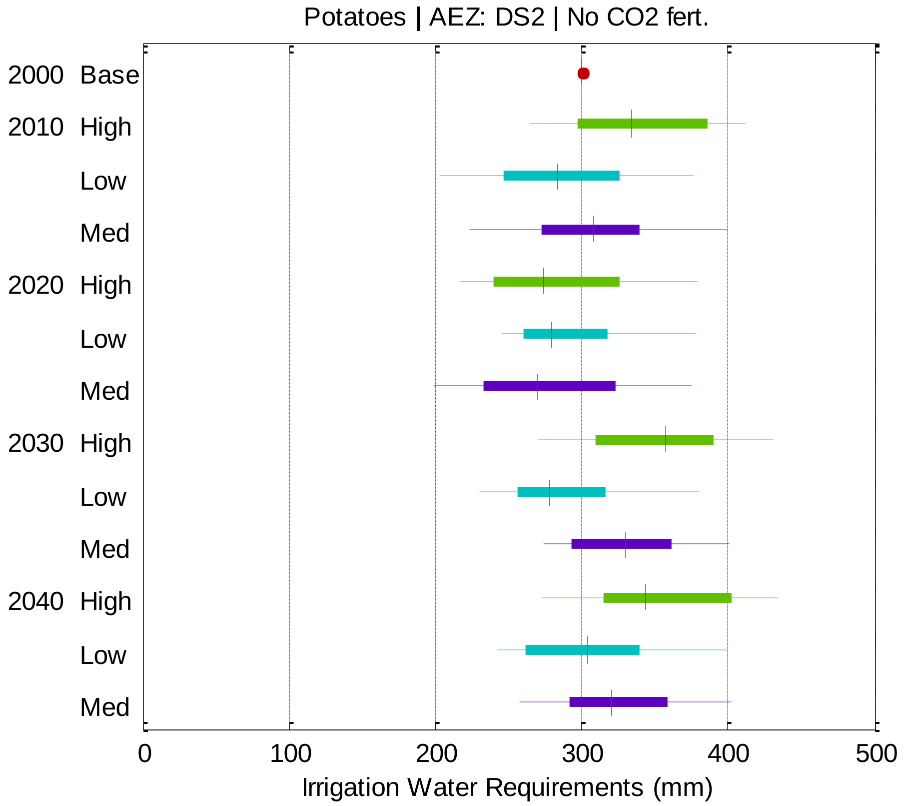

Table 1-29. IWR Statistics for Potatoes, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	342.0	49.2
2010	Low	289.1	58.8
2010	Med	311.3	58.4
2020	High	287.4	57.4
2020	Low	293.8	45.1
2020	Med	282.4	59.4
2030	High	351.9	53.3
2030	Low	291.5	49.1
2030	Med	332.8	45.6
2040	High	352.8	53.9
2040	Low	309.7	55.8
2040	Med	327.5	50.9

Figure 1-30. IWR for Potatoes, AEZ: DS2 | CO2 fert.

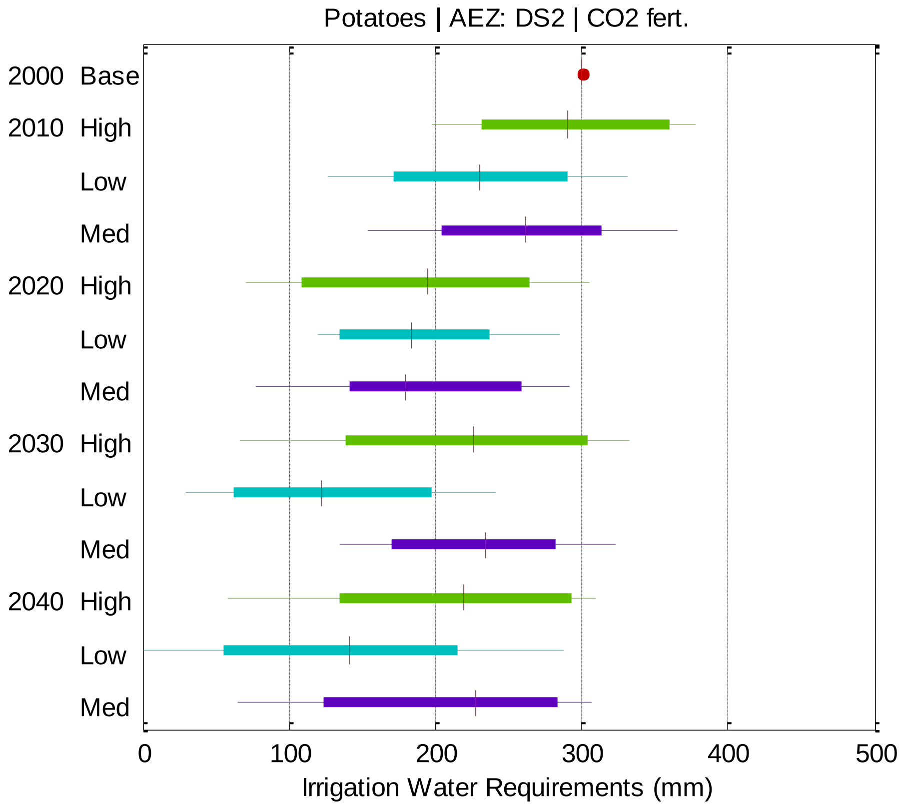

Table 1-30. IWR Statistics for Potatoes, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	291.7	64.2
2010	Low	233.5	71.4
2010	Med	265.3	73.1
2020	High	186.8	82.1
2020	Low	186.2	57.5
2020	Med	193.5	73.7
2030	High	221.8	92.3
2030	Low	132.6	73.0
2030	Med	231.5	68.0
2040	High	206.2	89.2
2040	Low	134.6	97.2
2040	Med	205.4	87.9

Figure 1-31. IWR for Potatoes, AEZ: DS5 | No CO2 fert.

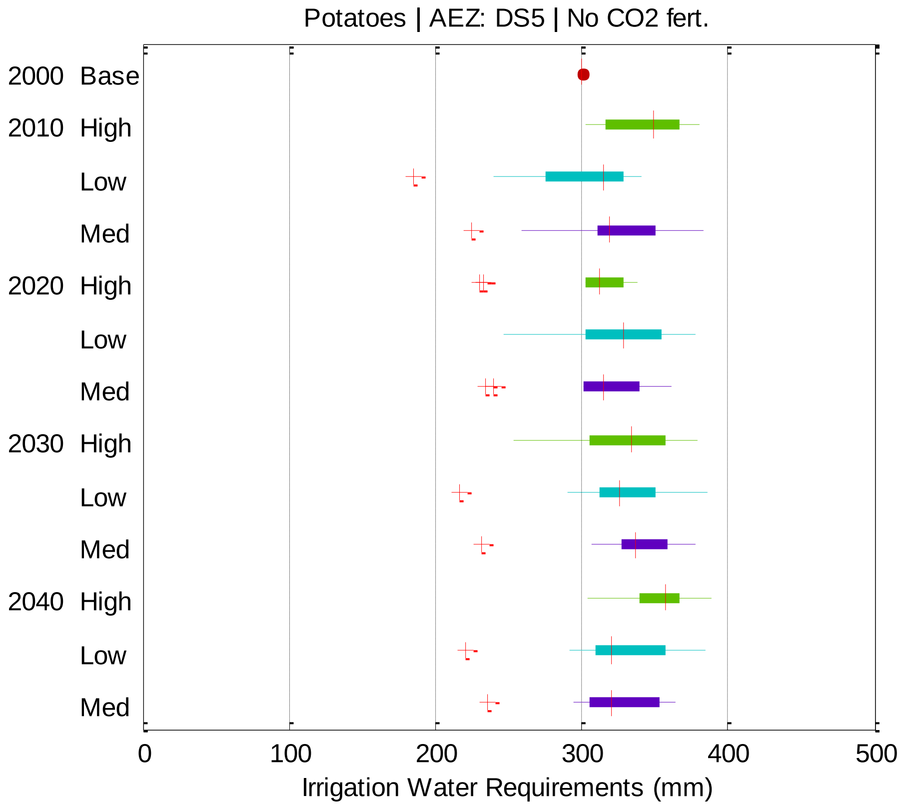

Table 1-31. IWR Statistics for Potatoes, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	345.7	28.6
2010	Low	296.9	49.9
2010	Med	316.5	46.5
2020	High	301.6	39.2
2020	Low	319.6	44.2
2020	Med	309.3	43.0
2030	High	327.3	42.9
2030	Low	323.5	46.7
2030	Med	332.9	41.1
2040	High	353.1	24.6
2040	Low	323.5	45.8
2040	Med	319.9	38.4

Figure 1-32. IWR for Potatoes, AEZ: DS5 | CO2 fert.

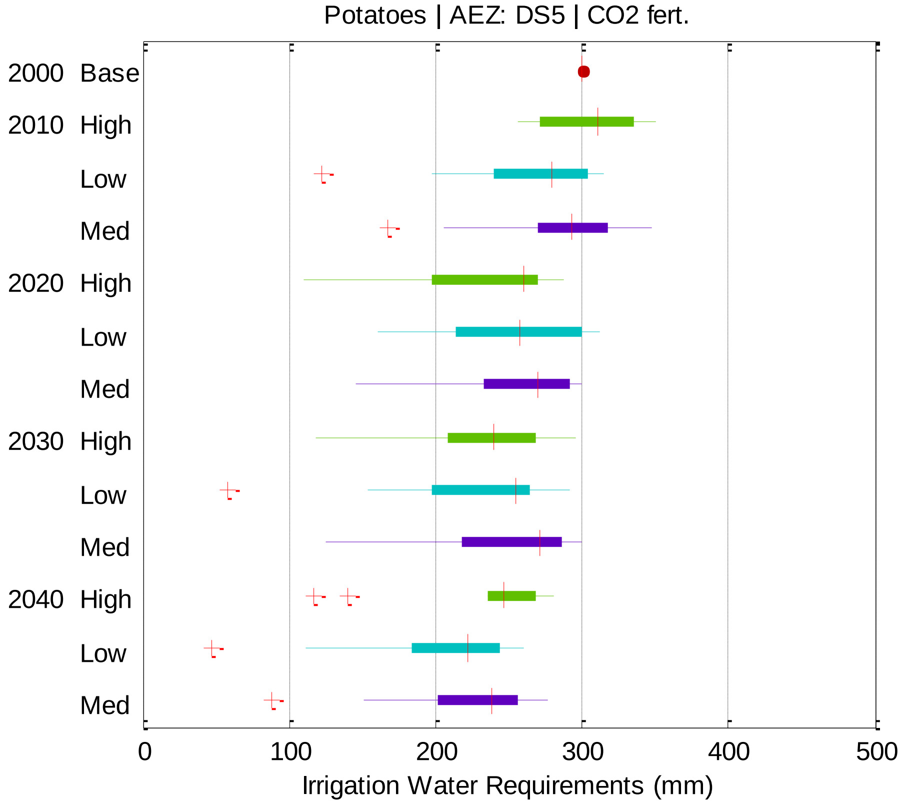

Table 1-32. IWR Statistics for Potatoes, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	306.1	35.1
2010	Low	260.1	61.1
2010	Med	280.8	56.6
2020	High	229.0	59.8
2020	Low	249.1	56.7
2020	Med	248.8	56.8
2030	High	225.5	60.7
2030	Low	223.7	71.3
2030	Med	251.3	55.6
2040	High	230.7	56.2
2040	Low	198.7	69.3
2040	Med	219.1	58.8

Figure 1-33. IWR for Potatoes, AEZ: HI3 | No CO2 fert.

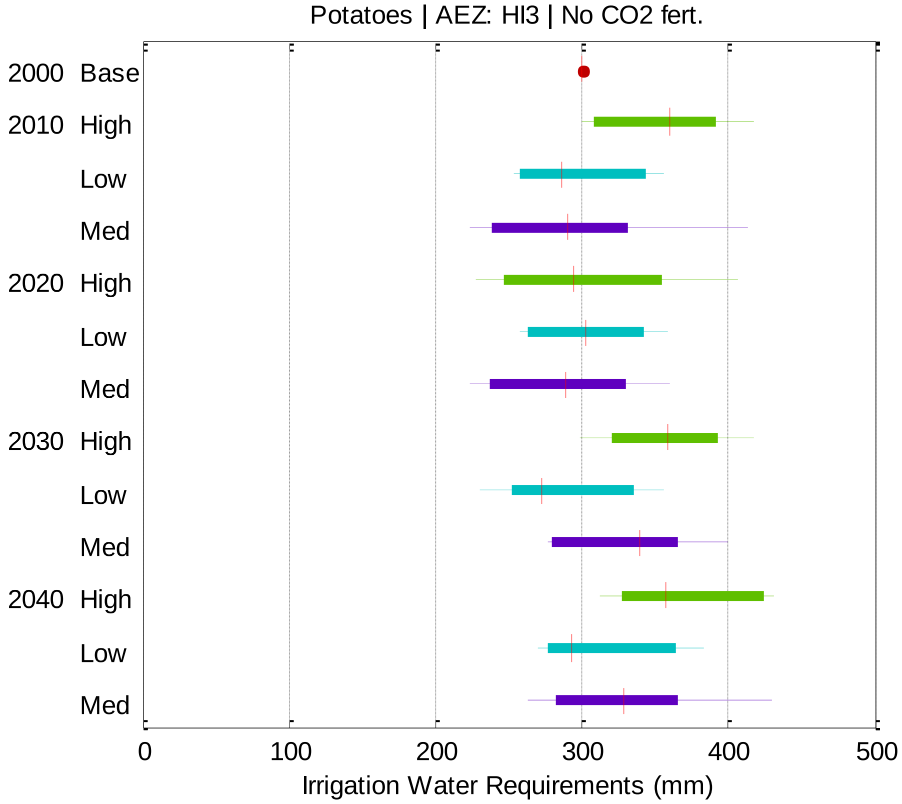

Table 1-33. IWR Statistics for Potatoes, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	354.7	43.9
2010	Low	296.6	40.7
2010	Med	301.7	63.5
2020	High	299.8	59.8
2020	Low	306.1	37.9
2020	Med	287.2	47.7
2030	High	358.6	43.4
2030	Low	285.7	46.1
2030	Med	332.1	46.9
2040	High	367.2	47.5
2040	Low	314.1	44.7
2040	Med	332.9	59.4

Figure 1-34. IWR for Potatoes, AEZ: HI3 | CO2 fert.

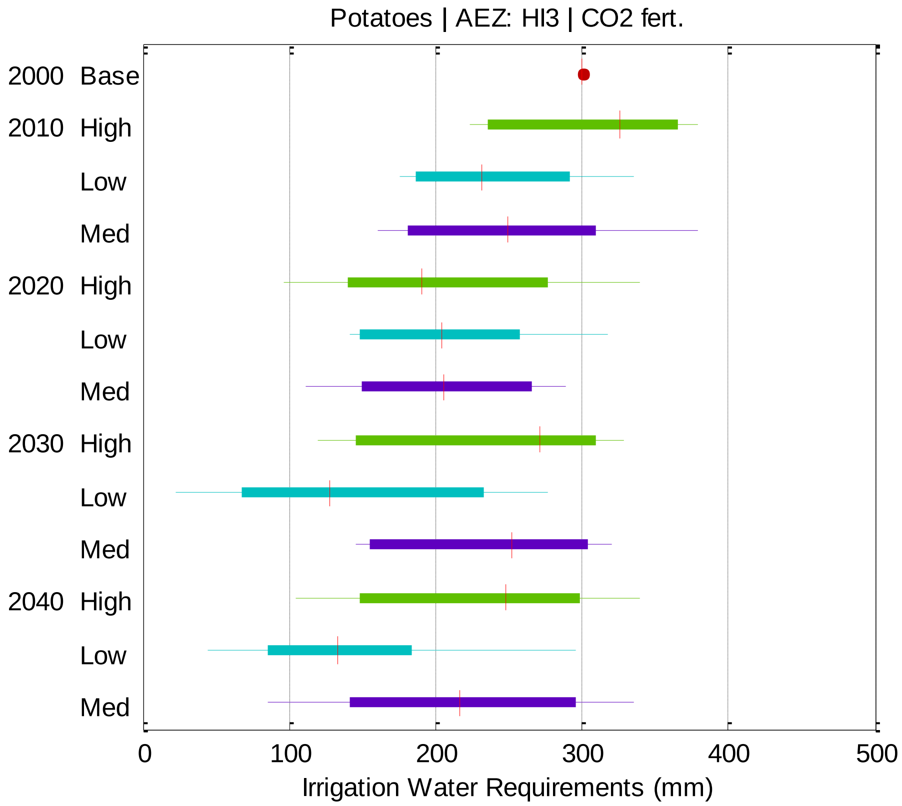

Table 1-34. IWR Statistics for Potatoes, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	304.0	65.1
2010	Low	242.5	58.1
2010	Med	256.6	77.0
2020	High	206.0	84.7
2020	Low	209.9	62.6
2020	Med	203.8	63.7
2030	High	232.9	84.3
2030	Low	145.4	91.0
2030	Med	233.3	72.2
2040	High	225.5	86.4
2040	Low	144.9	78.2
2040	Med	214.0	87.8

Figure 1-35. IWR for Potatoes, AEZ: PI1 | No CO2 fert.

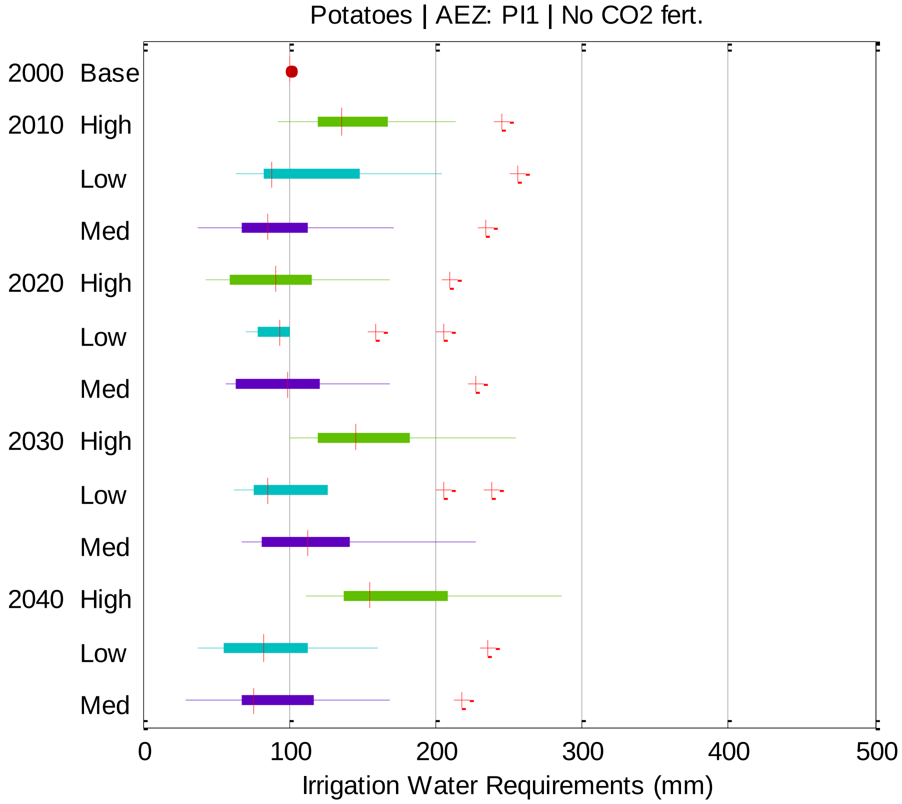

Table 1-35. IWR Statistics for Potatoes, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	100.0	0.0
2010	High	152.0	47.0
2010	Low	120.5	64.1
2010	Med	104.0	58.4
2020	High	100.9	52.4
2020	Low	105.6	43.5
2020	Med	109.6	54.2
2030	High	157.9	49.4
2030	Low	113.4	61.4
2030	Med	121.7	51.9
2040	High	174.1	54.0
2040	Low	98.4	59.3
2040	Med	97.7	56.2

Figure 1-36. IWR for Potatoes, AEZ: PI1 | CO2 fert.

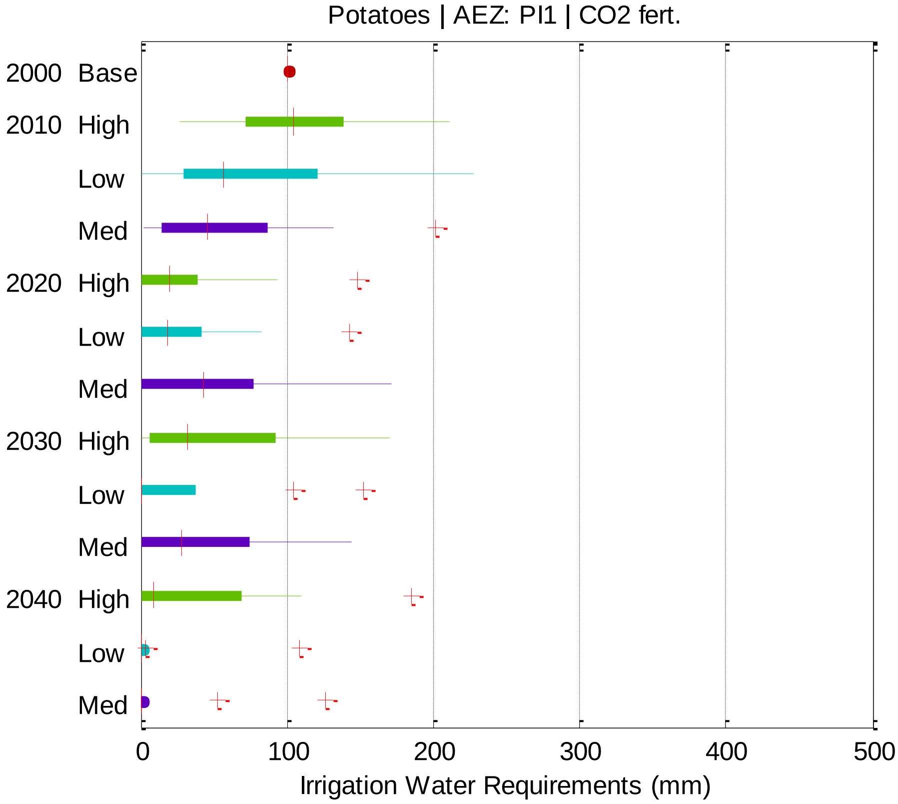

Table 1-36. IWR Statistics for Potatoes, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	100.0	0.0
2010	High	107.3	56.4
2010	Low	78.7	72.1
2010	Med	63.2	63.2
2020	High	34.2	49.2
2020	Low	34.3	47.2
2020	Med	49.5	54.8
2030	High	51.7	56.7
2030	Low	31.1	54.1
2030	Med	42.6	49.9
2040	High	43.3	62.5
2040	Low	11.2	34.4
2040	Med	17.8	41.4

Figure 1-37. IWR for Potatoes, AEZ: PI3 | No CO2 fert.

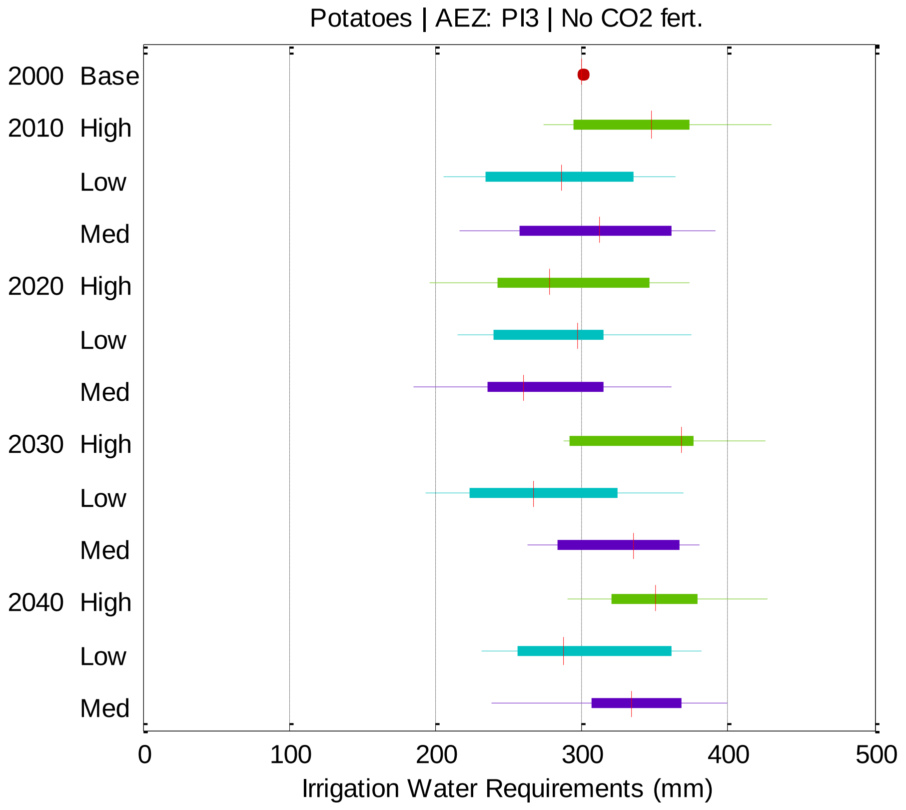

Table 1-37. IWR Statistics for Potatoes, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	343.6	49.0
2010	Low	284.2	55.5
2010	Med	304.3	61.8
2020	High	287.5	64.4
2020	Low	286.2	50.0
2020	Med	270.8	55.8
2030	High	351.7	51.0
2030	Low	274.6	57.4
2030	Med	327.5	48.5
2040	High	352.9	47.6
2040	Low	300.6	58.5
2040	Med	326.8	54.3

Figure 1-38. IWR for Potatoes, AEZ: PI3 | CO2 fert.

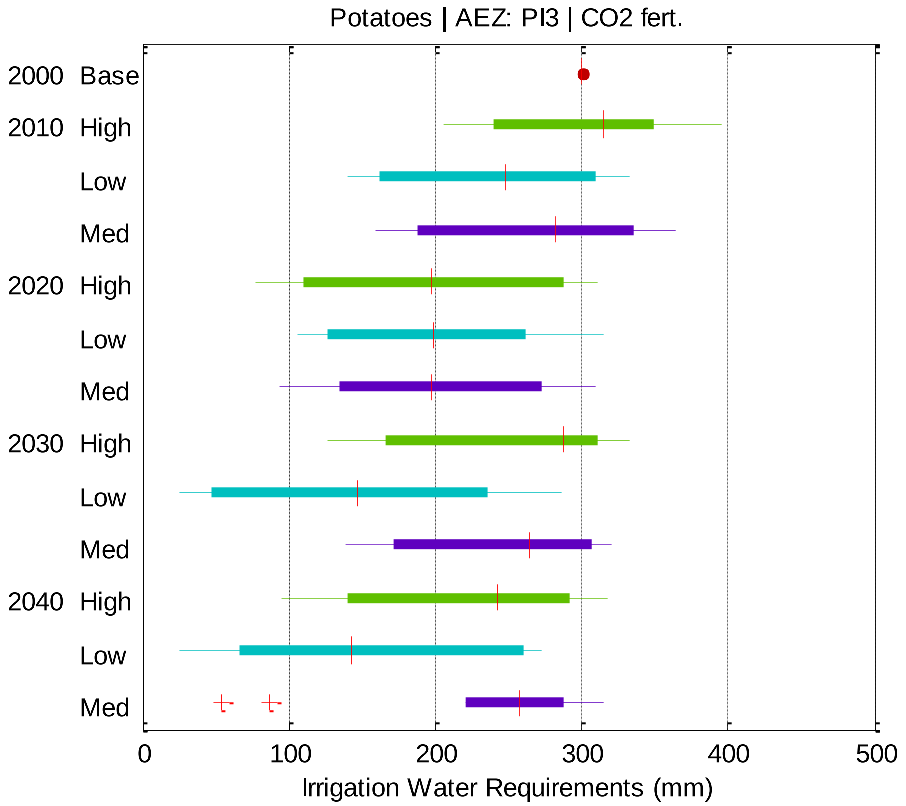

Table 1-38. IWR Statistics for Potatoes, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	302.7	63.4
2010	Low	239.4	73.1
2010	Med	264.1	77.5
2020	High	200.2	91.5
2020	Low	200.1	73.4
2020	Med	199.4	71.1
2030	High	251.1	80.3
2030	Low	146.9	94.8
2030	Med	244.1	73.0
2040	High	221.2	83.0
2040	Low	152.0	99.1
2040	Med	227.1	88.1

B.5 Tomatoes

Figure 1-39. IWR for Tomatoes, AEZ: DS2 | No CO2 fert.

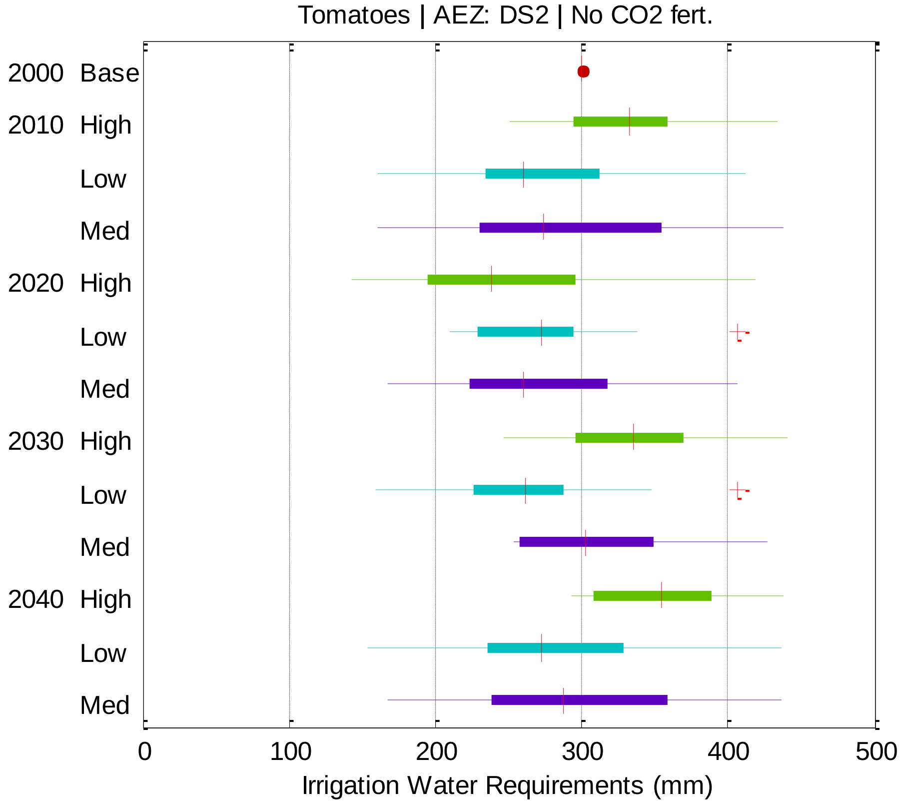

Table 1-39. IWR Statistics for Tomatoes, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	337.4	57.0
2010	Low	274.2	72.0
2010	Med	293.3	88.0
2020	High	252.4	87.4
2020	Low	276.5	60.5
2020	Med	270.1	70.6
2030	High	341.3	61.3
2030	Low	265.1	74.0
2030	Med	317.0	60.2
2040	High	353.9	51.0
2040	Low	285.4	86.4
2040	Med	300.0	83.0

Figure 1-40. IWR for Tomatoes, AEZ: DS2 | CO2 fert.

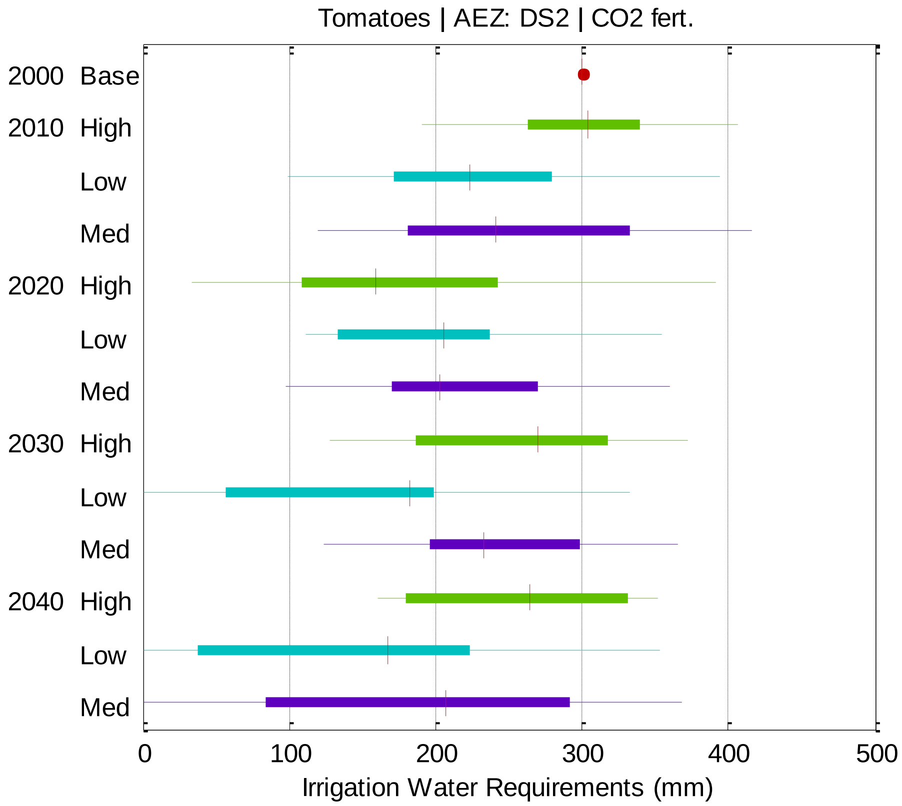

Table 1-40. IWR Statistics for Tomatoes, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	304.7	68.7
2010	Low	236.4	84.7
2010	Med	262.4	96.0
2020	High	178.8	112.8
2020	Low	206.6	76.5
2020	Med	212.4	79.8
2030	High	261.3	81.9
2030	Low	155.4	107.4
2030	Med	244.0	80.9
2040	High	255.3	75.3
2040	Low	158.9	117.8
2040	Med	199.3	122.6

Figure 1-41. IWR for Tomatoes, AEZ: DS5 | No CO2 fert.

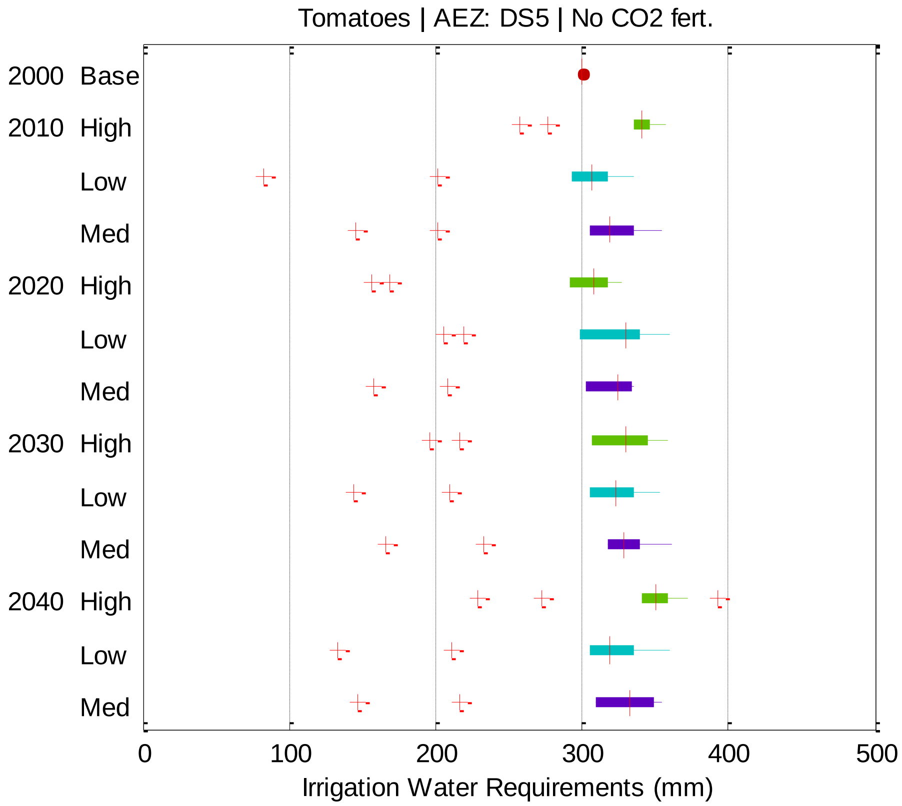

Table 1-41. IWR Statistics for Tomatoes, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	329.0	34.0
2010	Low	277.8	77.6
2010	Med	296.1	67.7
2020	High	281.6	63.4
2020	Low	306.8	53.5
2020	Med	296.6	61.9
2030	High	310.2	57.0
2030	Low	297.4	66.7
2030	Med	309.7	61.9
2040	High	337.3	49.1
2040	Low	295.5	69.5
2040	Med	305.6	68.7

Figure 1-42. IWR for Tomatoes, AEZ: DS5 | CO2 fert.

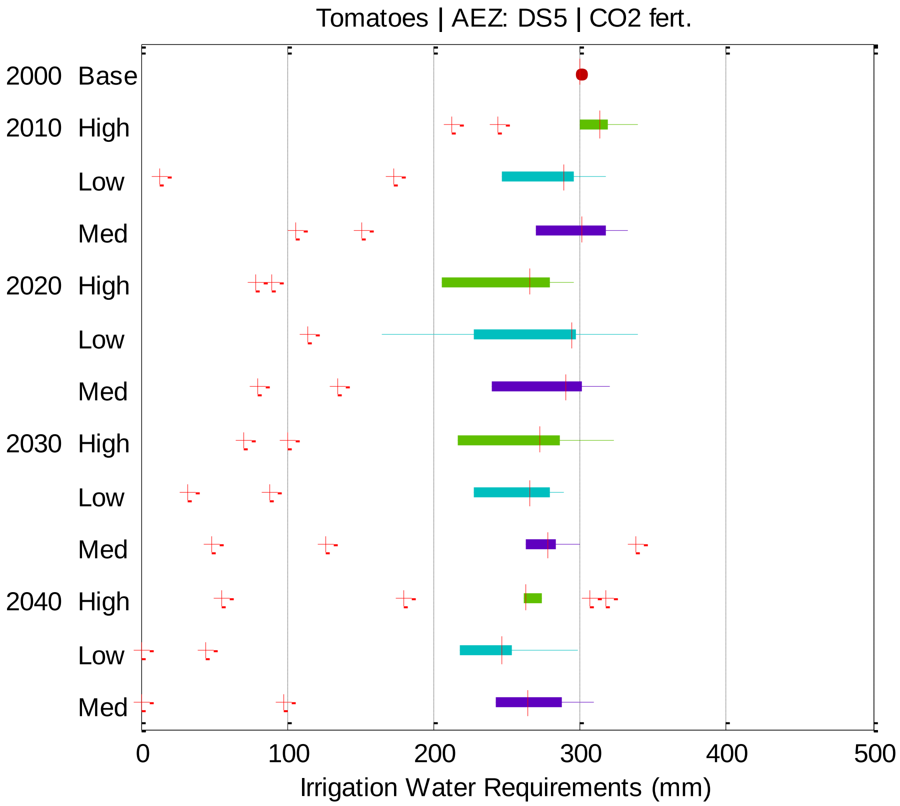

Table 1-42. IWR Statistics for Tomatoes, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	300.2	40.6
2010	Low	248.5	92.1
2010	Med	269.6	77.7
2020	High	228.5	80.3
2020	Low	257.6	70.4
2020	Med	252.2	80.7
2030	High	237.4	84.6
2030	Low	224.2	89.7
2030	Med	247.1	88.8
2040	High	244.7	76.0
2040	Low	206.7	99.8
2040	Med	228.9	99.4

Figure 1-43. IWR for Tomatoes, AEZ: PI1 | No CO2 fert.

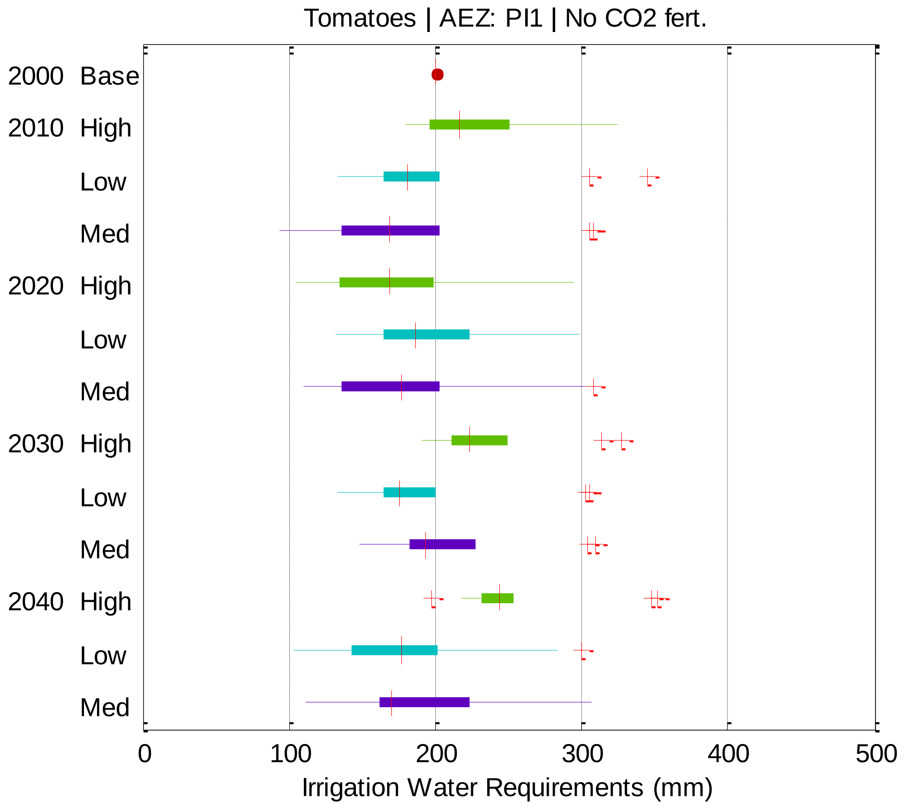

Table 1-43. IWR Statistics for Tomatoes, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	231.9	50.3
2010	Low	204.5	67.6
2010	Med	184.6	72.3
2020	High	180.1	66.7
2020	Low	199.5	55.7
2020	Med	188.2	68.2
2030	High	239.7	46.9
2030	Low	196.4	60.1
2030	Med	213.5	54.5
2040	High	257.7	51.2
2040	Low	182.7	66.4
2040	Med	191.8	69.0

Figure 1-44. IWR for Tomatoes, AEZ: PI1 | CO2 fert.

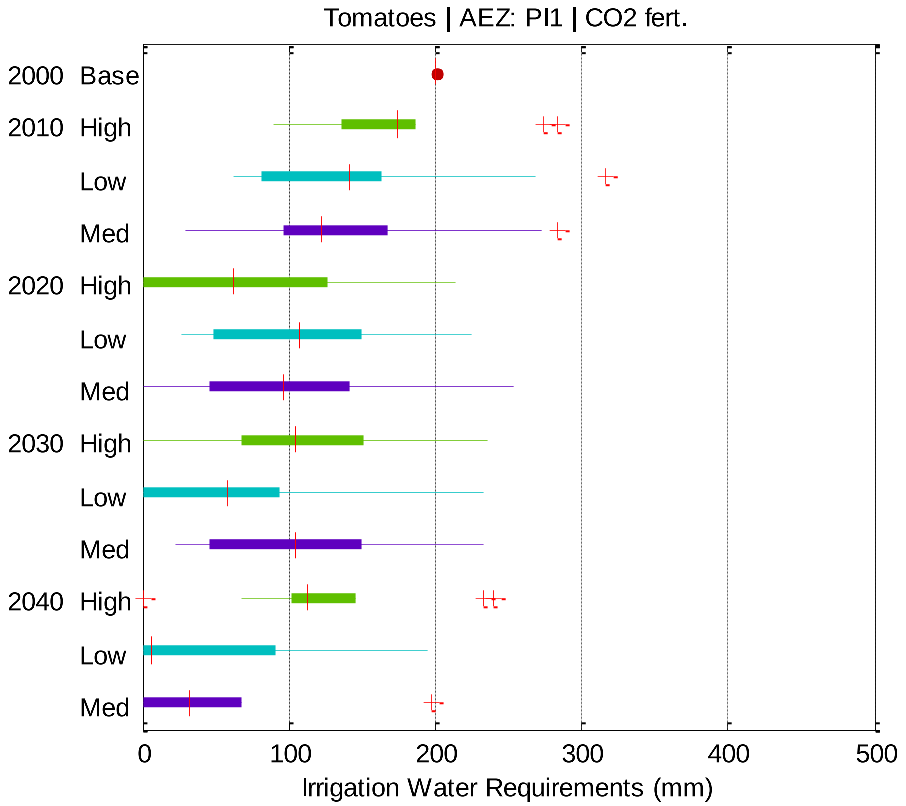

Table 1-44. IWR Statistics for Tomatoes, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	177.2	61.3
2010	Low	151.4	82.5
2010	Med	138.1	85.8
2020	High	80.3	82.2
2020	Low	109.3	72.0
2020	Med	106.1	88.5
2030	High	115.1	73.3
2030	Low	74.2	84.8
2030	Med	112.7	74.5
2040	High	126.2	71.6
2040	Low	51.1	75.6
2040	Med	59.0	77.8

Figure 1-45. IWR for Tomatoes, AEZ: PI3 | No CO2 fert.

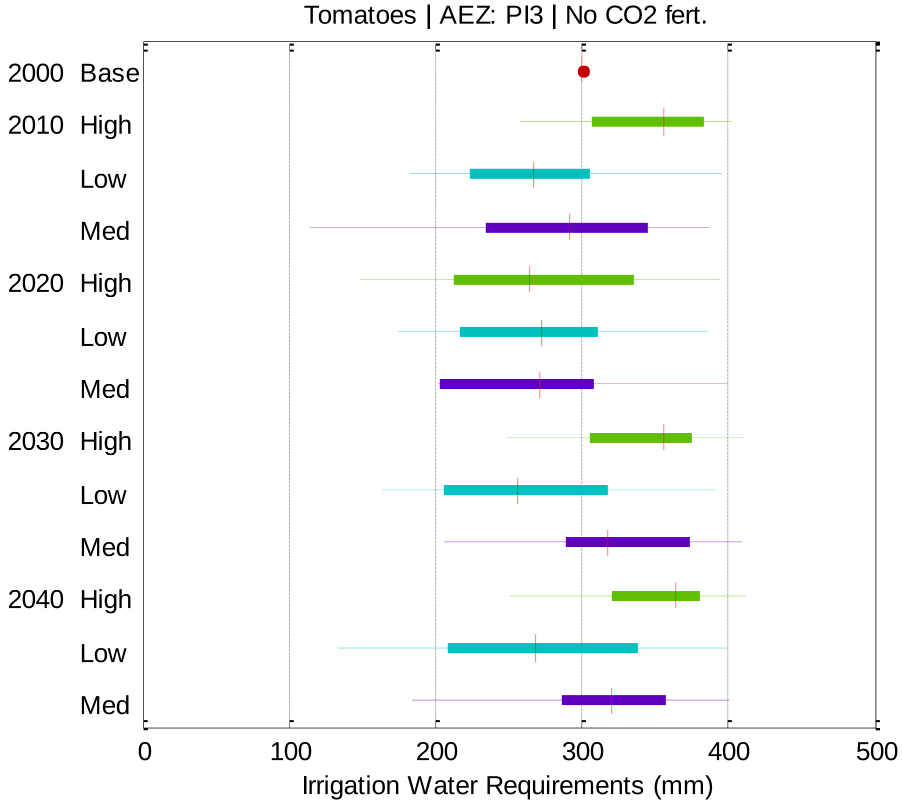

Table 1-45. IWR Statistics for Tomatoes, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	343.5	50.7
2010	Low	274.6	64.9
2010	Med	284.7	85.3
2020	High	270.8	85.8
2020	Low	270.3	61.8
2020	Med	268.5	66.0
2030	High	340.6	53.6
2030	Low	260.8	74.7
2030	Med	318.5	65.7
2040	High	350.8	51.2
2040	Low	270.2	84.0
2040	Med	310.5	70.4

Figure 1-46. IWR for Tomatoes, AEZ: PI3 | CO2 fert.

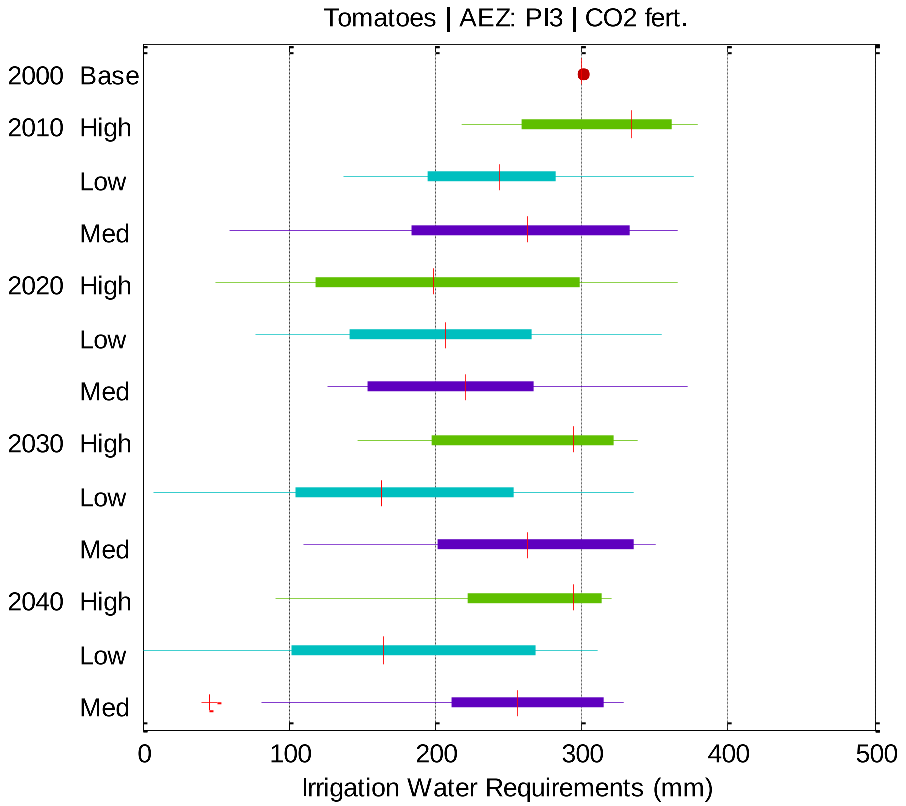

Table 1-46. IWR Statistics for Tomatoes, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	300.0	0.0
2010	High	315.5	60.5
2010	Low	243.8	76.3
2010	Med	255.7	97.2
2020	High	210.5	107.7
2020	Low	211.5	83.1
2020	Med	223.7	76.4
2030	High	268.9	71.9
2030	Low	168.3	108.8
2030	Med	254.5	85.3
2040	High	259.7	75.6
2040	Low	164.2	107.4
2040	Med	235.6	99.0

B.6 **Spring Wheat**

Figure 1-47. IWR for Wheat, AEZ: DS2 | No CO2 fert.

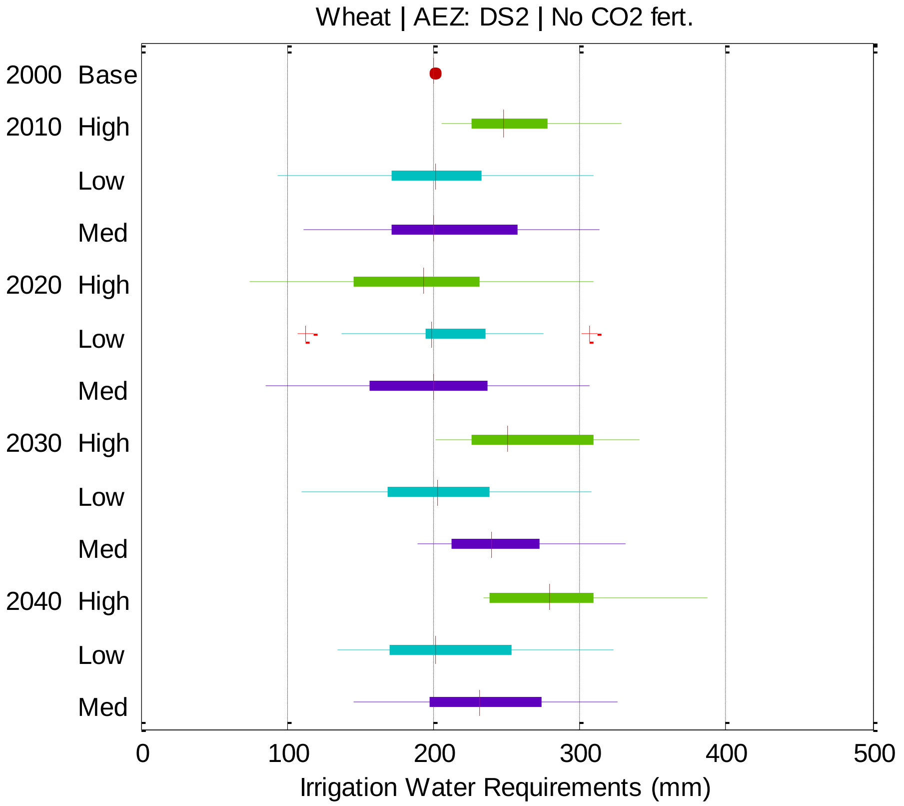

Table 1-47. IWR Statistics for Wheat, AEZ: DS2 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	256.7	38.6
2010	Low	203.0	64.8
2010	Med	211.9	65.4
2020	High	190.1	74.4
2020	Low	208.1	57.6
2020	Med	197.0	69.9
2030	High	264.7	51.8
2030	Low	204.5	63.3
2030	Med	246.7	44.7
2040	High	287.6	49.7
2040	Low	215.0	62.4
2040	Med	234.1	57.4

Figure 1-48. IWR for Wheat, AEZ: DS2 | CO2 fert.

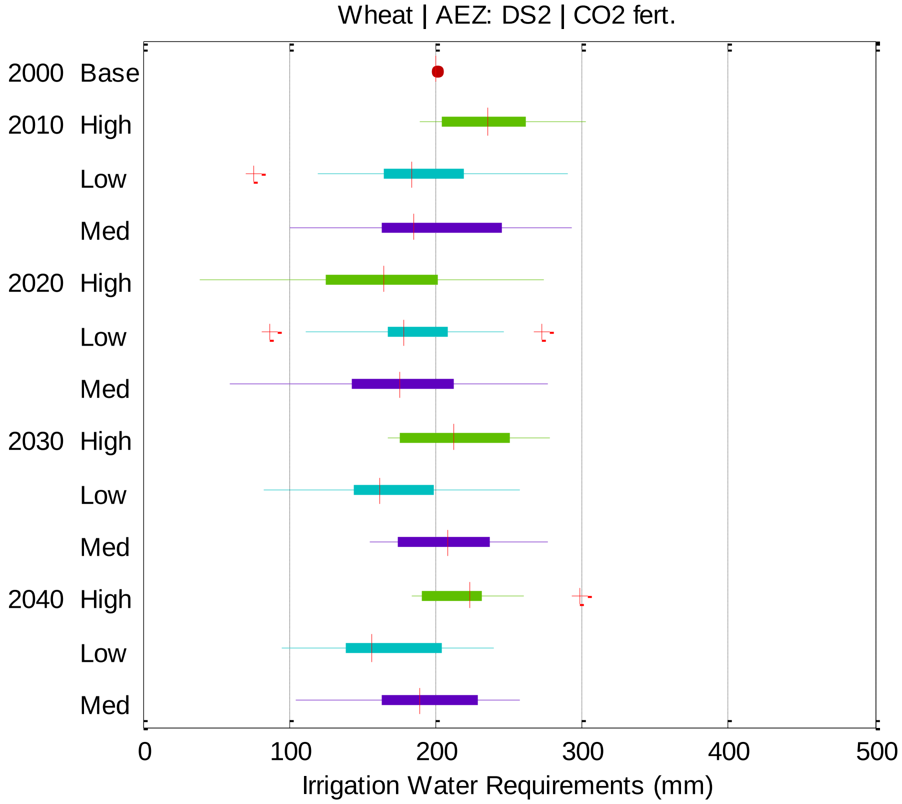

Table 1-48. IWR Statistics for Wheat, AEZ: DS2 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	238.5	36.5
2010	Low	187.4	63.2
2010	Med	197.5	61.9
2020	High	161.3	72.8
2020	Low	181.4	55.3
2020	Med	173.6	67.3
2030	High	218.3	42.1
2030	Low	166.1	57.2
2030	Med	210.5	38.0
2040	High	224.8	34.7
2040	Low	163.3	47.6
2040	Med	189.7	47.4

Figure 1-49. IWR for Wheat, AEZ: DS5 | No CO2 fert.

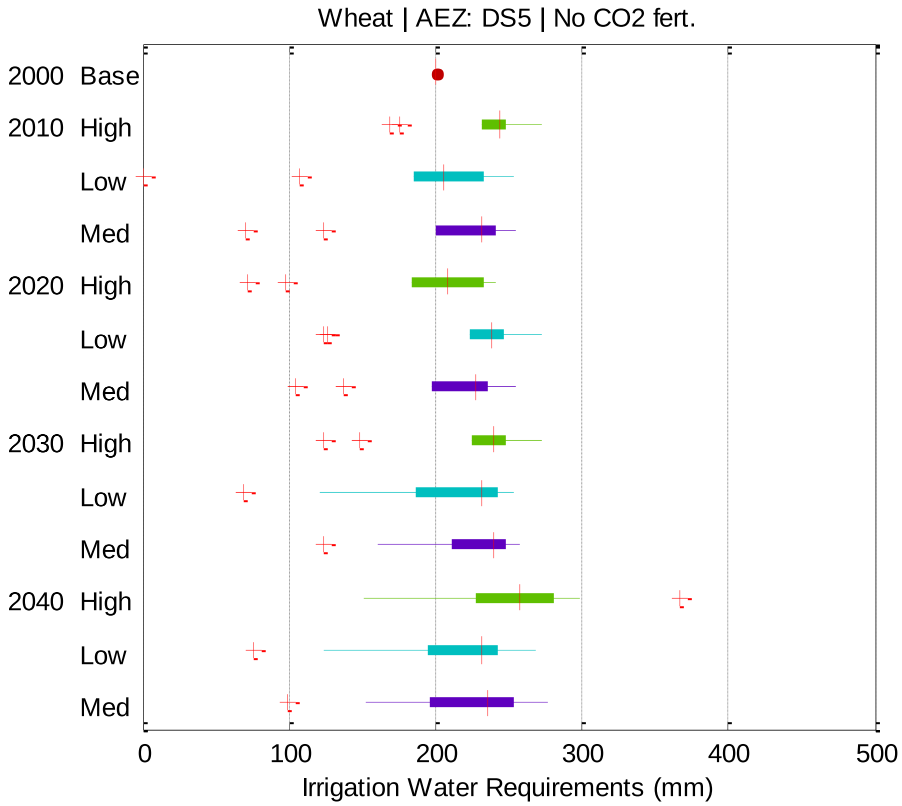

Table 1-49. IWR Statistics for Wheat, AEZ: DS5 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	234.0	34.8
2010	Low	184.4	76.3
2010	Med	204.4	60.0
2020	High	190.0	58.5
2020	Low	219.9	51.7
2020	Med	208.0	48.7
2030	High	224.4	49.4
2030	Low	202.5	61.0
2030	Med	220.7	44.2
2040	High	252.5	61.9
2040	Low	208.0	61.9
2040	Med	217.0	54.6

Figure 1-50. IWR for Wheat, AEZ: DS5 | CO2 fert.

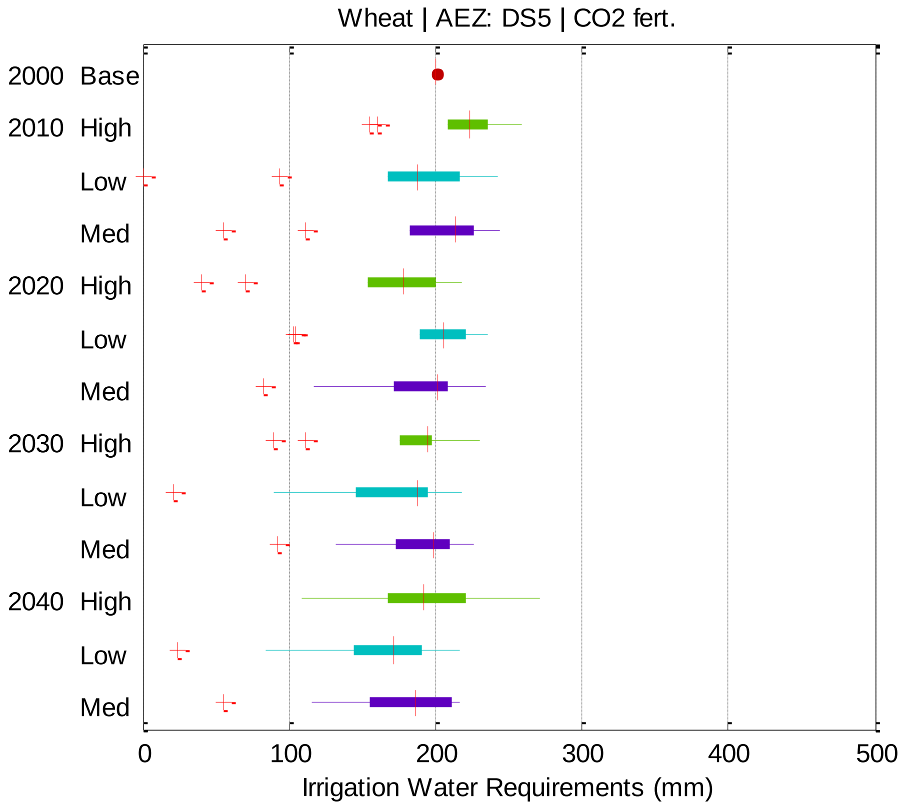

Table 1-50. IWR Statistics for Wheat, AEZ: DS5 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	216.1	33.9
2010	Low	170.8	72.2
2010	Med	189.5	59.7
2020	High	161.1	59.0
2020	Low	190.6	47.9
2020	Med	183.1	47.1
2030	High	179.5	44.3
2030	Low	160.3	60.6
2030	Med	184.6	41.6
2040	High	190.7	49.6
2040	Low	154.0	57.9
2040	Med	171.7	51.4

Figure 1-51. IWR for Wheat, AEZ: HI3 | No CO2 fert.

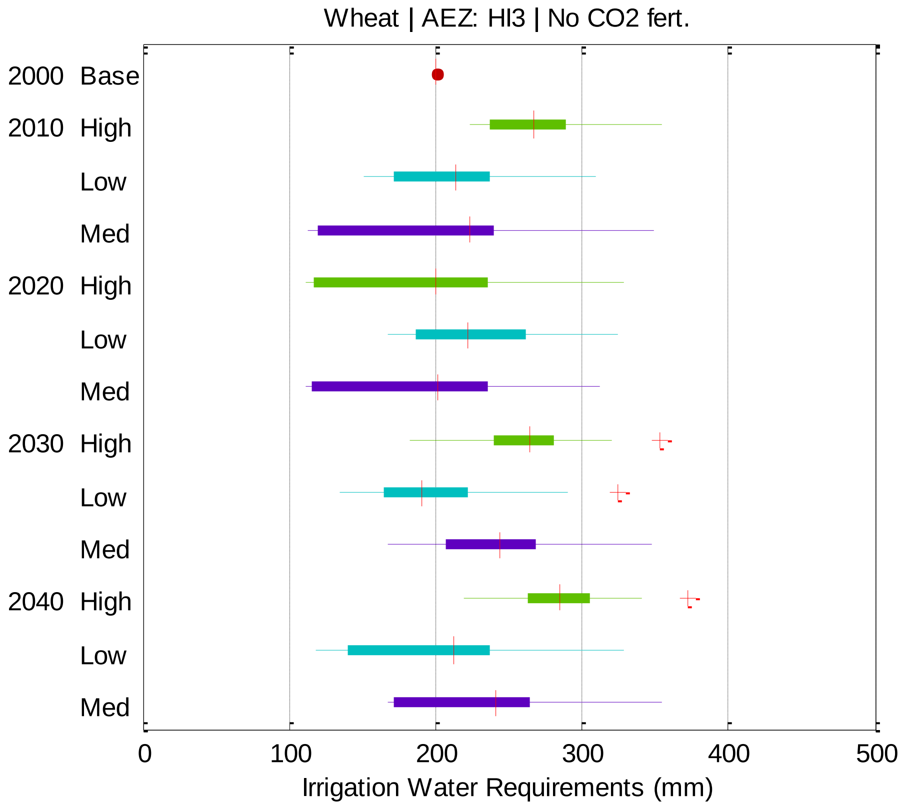

Table 1-51. IWR Statistics for Wheat, AEZ: HI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	272.4	41.5
2010	Low	216.9	52.0
2010	Med	204.7	83.5
2020	High	197.2	76.2
2020	Low	227.2	51.6
2020	Med	193.6	73.3
2030	High	264.9	47.5
2030	Low	204.4	62.3
2030	Med	242.6	55.0
2040	High	287.1	45.5
2040	Low	207.4	70.8
2040	Med	243.7	69.0

Figure 1-52. IWR for Wheat, AEZ: HI3 | CO2 fert.

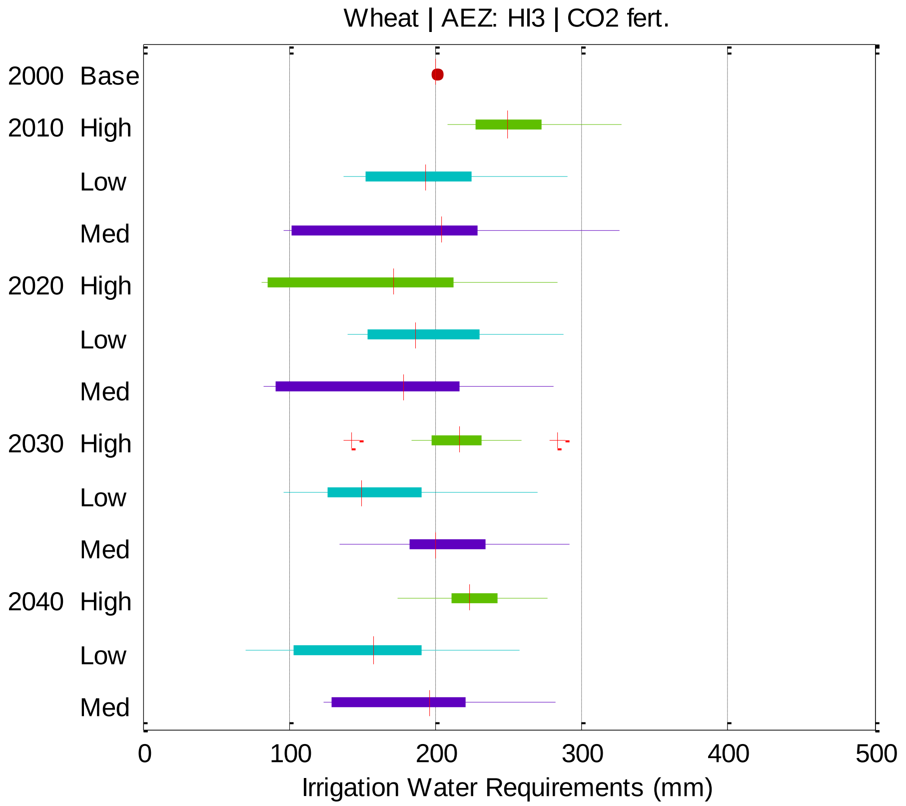

Table 1-52. IWR Statistics for Wheat, AEZ: HI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	253.5	38.0
2010	Low	200.2	51.0
2010	Med	188.2	81.9
2020	High	164.5	72.9
2020	Low	196.7	48.9
2020	Med	166.5	72.2
2030	High	217.0	38.5
2030	Low	162.1	57.7
2030	Med	204.7	46.7
2040	High	224.1	30.5
2040	Low	153.5	64.7
2040	Med	194.4	58.5

Figure 1-53. IWR for Wheat, AEZ: PI1 | No CO2 fert.

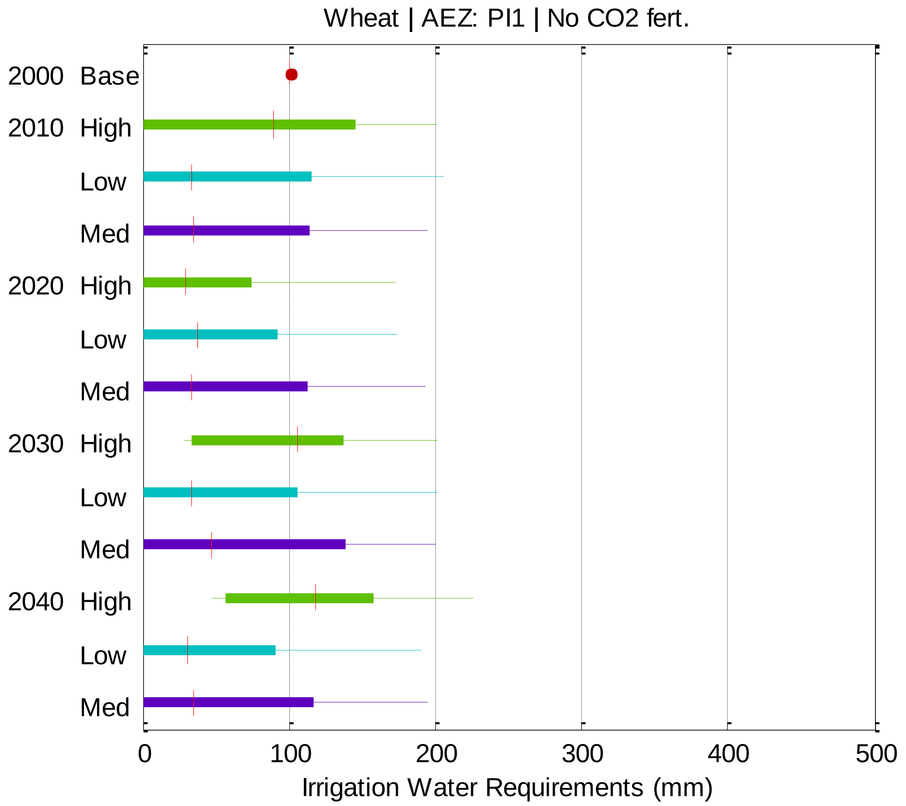

Table 1-53. IWR Statistics for Wheat, AEZ: PI1 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	100.0	0.0
2010	High	88.6	81.6
2010	Low	66.7	81.9
2010	Med	64.6	78.7
2020	High	54.5	69.4
2020	Low	59.4	71.0
2020	Med	65.3	78.4
2030	High	101.7	68.3
2030	Low	65.4	80.7
2030	Med	76.6	85.1
2040	High	119.0	68.2
2040	Low	60.1	73.9
2040	Med	64.6	78.6

Figure 1-54. IWR for Wheat, AEZ: PI1 | CO2 fert.

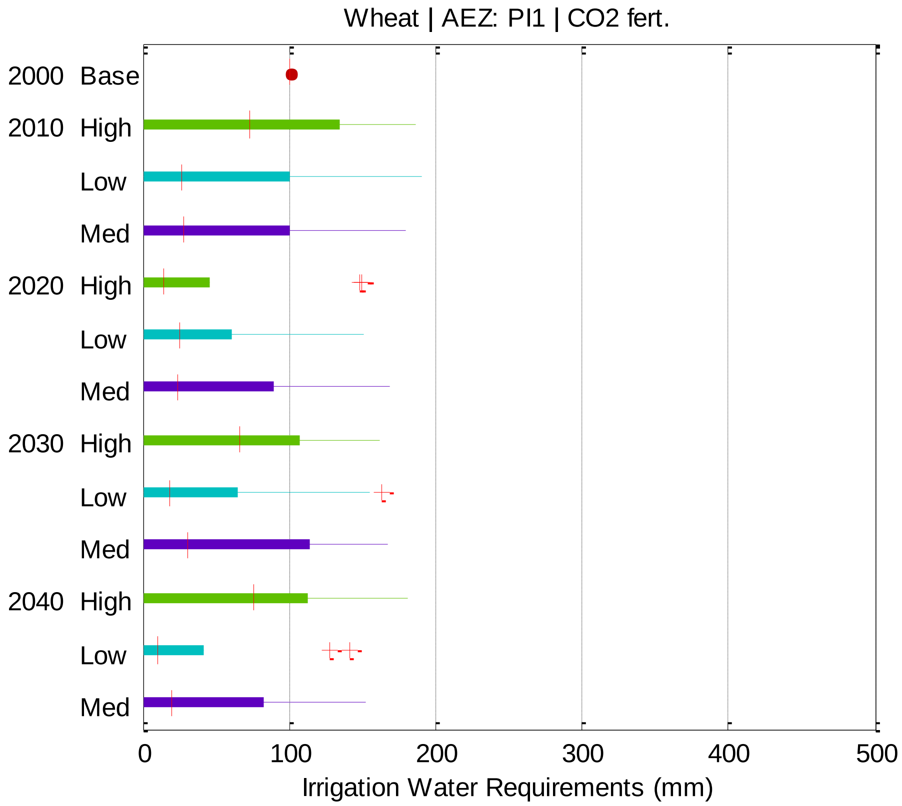

Table 1-54. IWR Statistics for Wheat, AEZ: PI1 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	100.0	0.0
2010	High	77.1	76.9
2010	Low	59.9	75.6
2010	Med	58.4	72.7
2020	High	41.5	59.3
2020	Low	46.4	60.3
2020	Med	54.8	68.3
2030	High	66.6	65.8
2030	Low	47.3	63.8
2030	Med	61.2	70.9
2040	High	73.4	70.6
2040	Low	37.0	54.0
2040	Med	47.6	61.3

Figure 1-55. IWR for Wheat, AEZ: PI3 | No CO2 fert.

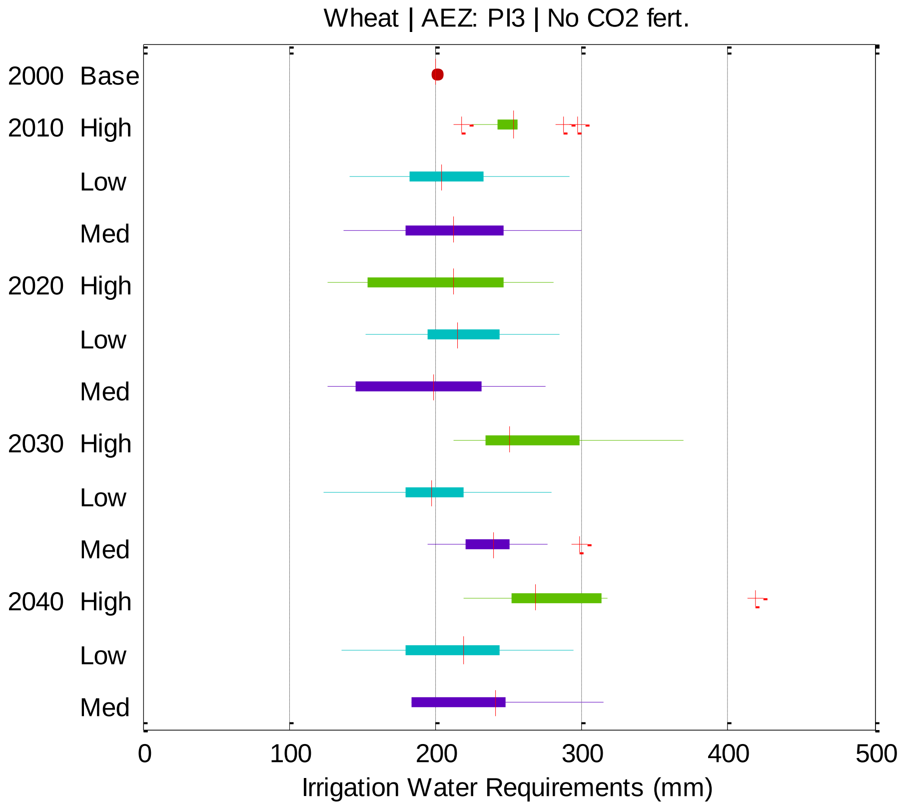

Table 1-55. IWR Statistics for Wheat, AEZ: PI3 | No CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	254.1	24.2
2010	Low	205.8	46.7
2010	Med	214.9	54.1
2020	High	204.3	53.2
2020	Low	217.3	37.4
2020	Med	195.8	50.0
2030	High	264.8	47.6
2030	Low	198.3	47.0
2030	Med	241.9	29.3
2040	High	281.8	57.3
2040	Low	213.9	49.0
2040	Med	236.0	45.3

Figure 1-56. IWR for Wheat, AEZ: PI3 | CO2 fert.

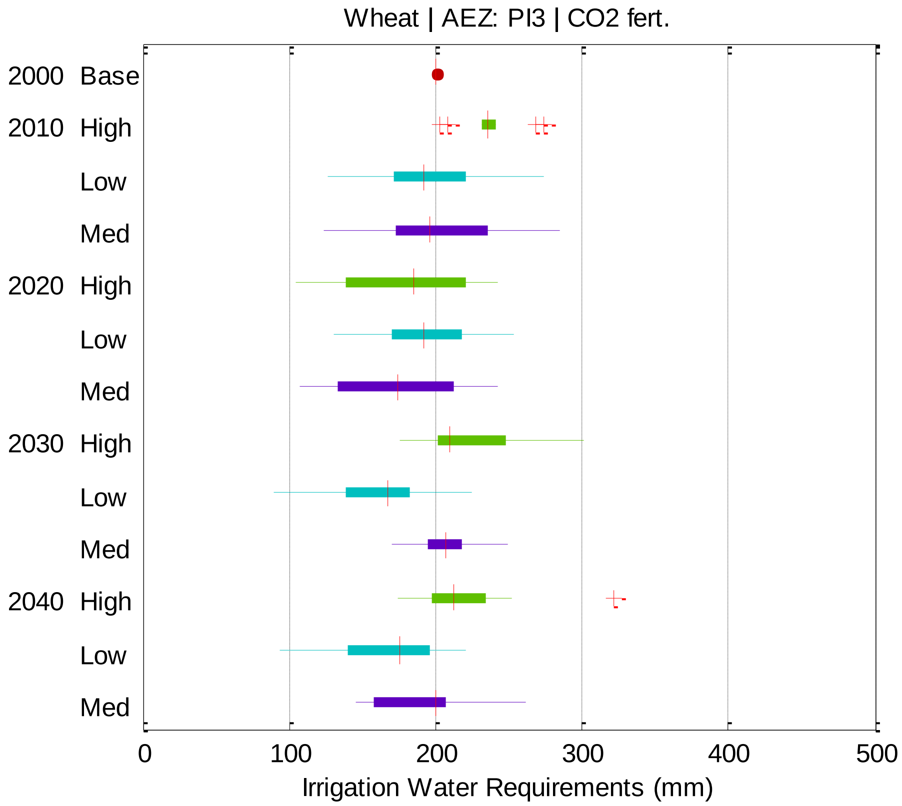

Table 1-56. IWR Statistics for Wheat, AEZ: PI3 | CO2 fert.

Period	Scenario	Mean	StDev
2000	Base	200.0	0.0
2010	High	236.9	22.0
2010	Low	192.0	45.3
2010	Med	201.2	52.2
2020	High	178.1	46.7
2020	Low	191.8	34.5
2020	Med	174.2	45.1
2030	High	219.8	37.3
2030	Low	161.4	41.6
2030	Med	207.9	21.8
2040	High	221.3	41.8
2040	Low	167.0	37.8
2040	Med	195.4	36.4