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Performance of agricultural factors on yield of sweet corn *(Zea mays* L. *Saccharata)* – A review

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SUMMARY

Sweet corn producers and industries require more reliable cultivars which could be accomplished by hybrid breeding. However, progressive phenological growth may be affected by different factors. In this paper, we analyze the key factors that determine the growth and yield of sweet corn. Environmental factors such as temperature and photoperiod were strong determinants of dates of flowering and harvest which are often crucial to yield in diverse climates and agricultural systems, besides the country's pedological conditions, especially soil fertility, affected phenological development. The effectiveness of fertilization in improving sweet corn growth performance was significantly influenced by the soil characteristics, the water supply, the genotype, and the agrotechnological factors. Therefore, genetic improvement of hybrids should be incorporated into the climate and soil elements to stabilize sweet corn yields in various agroecosystems. Decisions made in the sowing period are very significant, as up to 30% of the obtained yield may depend on making the proper choice. Deviation from the optimum date (either early or late sowing) may decrease yield. When deciding about the sowing date of maize, one needs to consider climate, soil quality, geographical location, temperature, weed infestation, sowing seed quality, and the ripening time of the hybrid to be produced.

Keywords: *agricultural factors; growth; yield; sweet corn*

INTRODUCTION

Sweet corn is an early harvesting maize type consumed as a vegetable it belongs to the family Poaceae and takes the third rank after rice and wheat in cereal crops. The chemical content of corn identifies it from other maize types, in recent varieties such as (SU1), (SH2), and enhancer varieties, varieties suppress the conversion of sugar to starch and become sweeter than other types by storing more sugar in the endosperm (Szymanek, 2009).

Sweet corn (*Zea maize* L.) is considered a vegetable and is characterized by a sweet taste, thin endosperm, and pericarp with a soft texture and high nutritive value (Kwiatkowski and Clemente, 2007). It is used fresh or processed in addition to the use of its straw for animal feeding (Teixeira et al., 2001). Brazil produces sweet corn on about 36 million hectares annually attaining about 10–12 tons per hectare (Barbieri et al., 2005; Kwiatkowski and Clemente, 2007).

There is no recent data for crop yield up to now. The main difference between sweet and common corn is the genome of sweet corn in which at least one of 8 genes controls endosperm carbohydrate synthesis as a result of mutation which suppresses the conversion of carbohydrates into starch (Tracy et al., 2006; Qi et al., 2009).

Morphology and production technology of sweet corn (*Zea maize var. sacharata*{sturtev} L.H. Bailey) resembles other varieties with some differences, the main difference is that rich protein-containing kernels of sweet corn together with fat and sugar (Budak and Aydemir, 2018) sweet corn characterized by juiciness, sweetness, and tasty characters in milk stage (Ugur and Maden, 2015) its kernels consumed fresh or processed (Rattin et al., 2018).

Sweet corn is a type of maize harvested in its early stages and consumed as a vegetable. It belongs to the Poaceae family and genus Zea, although sweet corn is used and accepted as a vegetable rather than maize, maize is considered the third most important cereal crop in the world after wheat and rice.

Short growth habits and chemical content distinguish sweet corn from other types of corn sugary1 (su1), shrunken2 (sh2), and sugary enhancer1 (se1 alleles) of sweet corn varieties characterized by reducing translocation of carried sucrose and sucrose conversion to starch in seed endosperm resulting in higher sugar content of grain sweet corn fat and protein ratio is higher than other types of maize due to the larger embryo size of sweet corn (Szymanek, 2009).

The stability of crop yield is a very important factor for sustainability it can be affected by weather, crop cultural practices, soil factors, and land preparation, all those factors can surely affect crop production (Pareja, 2020). In the last three decades especially since the 1990s climate change has become a big challenge facing crop production around the world. Together with soil deterioration, due to degradation and soil pollution by chemical residues (Diacono, 2010) abiotic stress facing crop production is the main factor threatening production systems.

Sweet corn production in regions affected by climatic and soil changes will give fluctuated and unstable yield, in addition, an increase in sweet corn demand makes a need for more sweet corn supply even out of season which is considered a challenge because corn kernel quality deteriorates after milky stage (Alan et al., 2014) changing sowing days of sweet corn by

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early or late transplanting is the solution for sweet corn great demand, which result in extending harvest time by growing corn earlier or later than recommended sowing date. In early sweet corn sowing (spring) plants face cold stress which results in low seed germination and reduces the number of plants by total area (Hassell et al., 2003; El-Hamed et al., 2012). While late corn sowing corn crop faces several insects and diseases (Williams, 2008) also plants will be exposed to heat stress and drought due to high temperatures (Heshemi et al., 2017; Tabakovic et al., 2020). Sweet corn (*Zea mays saccharata*) can fulfill the foodstuff needs and nutrition requirements of human beings (Surtinah, 2020).

Sugary kernels of sweet corn (*Zea mays* ssp. *saccharata*) became considerable vegetative stage due to its high sugar content rather than starch, it is consumed daily fresh or frozen in salad preparation. Sweet corn is harvested in the milky stage before the conversion of sugars to starch at the full ripening stage, in the milky stage moisture content of kernels ranges between 72–76% (William, 2014).

Three kinds of sweet corn: normal sugar enhanced and super sweet, those types are different in flavor and texture according to sugar content. Higher sugar content varieties remain sugary even at full maturity. Sweet corn contains 5–6% sugars, 10–11% starch, 3% polysaccharides soluble in water, and 70% water content and moderate protein levels. It also contains potassium and vitamin A in yellow varieties, (Szymane, 2005 and Ugur, 2015).

This review work focuses on the Performance of Agricultural factors on yield of sweet corn research from (2014–2021) Database (Web of Science).

CULTIVATION OF SWEET CORN

Corn is mainly cultivated in dry paddy fields during the dry season after rice crop, in corn production there are a lot of constraints facing growers, in dry lands limited availability of soil moisture is the main problem, as the high need for nutrients by the plant because of the high need of maize to fertilizers application for yield increasing near to potential. Results of the fertilization model developed for 12 site-years of data each with 10 N rates, it was found that the best economical rate for N fertilization is between 128–379 kg ha^{-1} (Fageria, 2011; Hammad et al., 2011) concluded that from 4 N doses (150, 200, 250, 300 kg ha^{-1}) applied under semi-arid conditions, highest dry matter for grain yield between 7.8 t ha^{-1} achieved at 300 kg ha^{-1} N under 8 irrigations. Thus, the conversion of 300 kg ha^{-1} N to urea (45% N) is equivalent to 667 kg ha^{-1} urea needed for fertilization of sweet corn to ac achieve high yield.

Sweet corn is distributed mainly in temperate and tropical zones, globally about one million hectares are harvested annually (USDA, 2010). Natural spontaneous mutation in endosperm kernels which approve sugar to starch conversion genes occurs in field corn and results in current sweet corn varieties, several mutations responsible for sweet corn different types. The sugary1 (su1) mutant used traditionally since pre-Columbus times and contains about 5–10% sugar by weight. The shrunken2 (sh2) mutant has a high harvesting period and possesses better responses to market demands due to the replacement of the su1 variety in processing (Marshall and Tracy, 2003).

On the other hand, common corn takes 150–180 days to harvest after planting, while sweet corn is harvested when endosperm sugar becomes higher within 21 days after flowering or 90 days after planting (Marshall and Tracy, 2003).

Corn is one of the most widespread cereals cultivated globally, corn kernels are rich in saccharose and protein together with minerals and vitamins (Gao, 2020). Thus, it’s used for human nutrition and animal fodder, corn popularity increased because of its short growth cycle and its good economic potential. Weather condition especially temperature affects growth, quantity, and quality, amount of yield affected by weather conditions especially temperature within the vegetative stage, also cultural practices and fertilization have a role in crop growth.

Excess irrigation can suppress corn growth, uncontrolled water availability can lead to the filling up of kernels and limitations in root growth (Rosa, 2015; Datta, 2019) sweet corn, especially at vegetation onset of vegetation competes with weeds, which can cause 85% reduction in yield and reduce the overall quality of produced crop (Rosa, 2015; Williams, 2010). High-quality seed sources ought to ensure cultivar purity, which is characterized by healthy and sufficient sprouting and vigor. At harvest, corn seeds show several treatments for quality improvement, including priming, granulating(coating), and conditioning. due to high chemical usage in production, there is a need for environment-friendly food production. (Krawiec, 2018).

Sweet corn (*Zea mays* L.) is considered a warm season crop adapted to temperate areas (Aguyoh et al., 1999) 20–30 degrees centigrade and 75–100% relative humidity with 100% field capacity are the ideal growth requirements for corn (Schneider and Gupta, 1985; Stall et al., 2019; Edward, 2020). Weeds can destroy the cultivation of corn in addition to the decline in yield of 24%, while diseases and pests can cause a 16.4–11.2% reduction in yield respectively (An et al., 2001).

The harvesting stage is very crucial in corn, it affects the quality and quantity of silage material. The use of silage by cattle depends on the maturity stage at harvest, the growth stage can affect silage digestibility for animals and consumption quantity. Corn forage variety is characterized by stable quality at maturity due to grain development in cob-compensated leaf and stem the high levels of fiber. Variability in dry matter and differences in nutritive value are affected by the growth stage (Demirel, 2011). Many studies showed that a better growth stage for harvesting the crop is between yield and quality of forage, when silage is made the biggest concern is the role of plant nutritive value on quality of fermentation. High dry matter loss can result from few fermentations, also few fermentations can cause low aerobic stability, and reduce the quality of

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silage for animal feeding (Schroeder, 2013) concluded that the hybrid selection of corn can affect corn silage in different ways, grain yield at harvest, and digestibility. Breeders make selections via grain yield and the majority of them say that the best grain varieties are also the best forage verities (Lee, 2005; Ferraretto et al., 2015) obtained that leafy corn hybrids have a good effect on the performance of animals when used as silage, but (Darby and Lauer, 2002) observed that no clear differences in hybrids for forage, silage, and stover yield.

Yield of sweet corn

The usage of chemical fertilizers in sweet corn production is more effective than organic fertilizers, however continuous use of the organic production system of maize can help in the accumulation of nutrients in soil together with providing a suitable environment for beneficial microorganisms growth which can help sweet corn later to face climatic changes (Ping, 2020).

Genotype stability within different environments is a favorable genetic trait for processing rather than a stable yield of variety in specific locations, the best genotype is one that possesses both the highest average yield and genetic stability in different conditions (Martin, 2017)

In Pekanbaru sweetness of corn makes it more favorable but the production quantities there are still low compared to other country regions. This is due to the effect of environmental factors, especially Red Yellow Podsolik lands (PMK). PMK soil became poor in nutrients as a result of long use, but the usage of sufficient organic and inorganic fertilizers in the maize cultivation process can help in this case. Also, research in corn fertilization can improve yield but the result of the research is still not sufficient to achieve targeted goals (Surtinah, 2020).

Plant lodging and WCR larvae which destroy maize root system and suppress water and nutrient uptake by crops are threatening factors for maize resulting in yield reduction and harvest losses (Chiang, 1973; Spike and Tollefson, 1989). In addition, silk clipping as damage caused by WCR adults can lead to fertilization and seed set failure (Culy et al., 1992) yield and quality of maize are affected by pollination, fertilization, and silk formation processes.

In maize male(tassel) and female parts (ear) found in the same plant, pollen shed occurs a few days before silk emergence and continues for 2 weeks, depending on variety and weather one male tassel can produce about 2–5 million pollen grains.

The primary WCR damage is caused by larvae destroying the maize root system resulting in reduced water and nutrient uptake and subsequent yield, plant lodging that leads to reduced yield and often harvest losses (Chiang, 1973; Spike and Tollefson, 1989). Moreover, WCR adults feeding on the silk of maize may cause economic damage by silk clipping, resulting in reduced fertilization and kernel set (Culy et al., 1992). Silk formation, pollination, and fertilization in maize is an important process that determines grain yield and quality. In the case of maize, male (tassel) and female (ear) plant parts are present on the same plant. Pollen shed from tassels usually starts a few days before silk emergence and lasts for about two weeks, depending on the maize variety and weather conditions. One tassel produces 2 to 5 million pollen grains, every one silk contains about 2000–5000 pollen silk (Madison, 2014).

The genetic stability of a crop refers to its performance in different environments; researchers can predict a variety of yield changes in different environmental factors (Becker and Leon, 1988). Genotype genetic stability should be constant in different environments compared to other varieties, in other words, variety should be stable and less sensitive to environmental change (above-average stability) or more sensitive to environmental change (below-average stability) relative to other genotypes, ideal genotype should perform well and not affected too much when growing in different environments (Dia et al., 2016; Lu'quez et al., 2002; Mohammed et al., 2016).

Up to now the concept of yield stability is still unknown well, while commercial cultivars of sweet corn can tolerate stress and diseases (Pataky et al., 2011), herbicides (Nordby et al., 2008), and weed competition (So et al., 2009) In addition recent processing varieties can perform well with different seed rates (Williams, 2012). A survey made by grower's fields, (Williams, 2012) showed that genotypes tolerant to density are underplanting, there is evidence for yield increasing by growing those density-tolerant varieties using a high seed rate (Williams, 2012, 2015).

The yield stability of sweet corn is unknown. Commercial sweet corn genotypes vary in tolerance to several stresses, including diseases (Pataky et al., 2011) herbicides (Nordby et al., 2008), and weed interference (So et al., 2009). More recently, differential tolerance to plant population density has been reported among sweet corn genotypes grown for processing (Williams, 2012). Based on surveys of grower's fields (Williams, 2012) found that density-tolerant genotypes were being underplanted. Multiple lines of evidence indicate that growing density-tolerant genotypes could increase sweet corn yield at higher plant densities than currently (Williams, 2012, 2015).

Interaction between improved genetics and agronomy results in modern corn (*Zea maize*) (Duvick, 1997; Duvick, 2005). Genetically tolerance to both biotic and abiotic stress of current maize is significant (Tollenaar, 2002). High plant density use became possible in the last century by attaining density-tolerant varieties (Duvick, 1997). Thus, the yield of current varieties is a result of developing hybrids that tolerate high density.

Within current sweet corn tolerance to high plant, density varies between hybrid varieties (Williams, 2012; Williams, 2015). Differences in yield were shown when 26 hybrids were planted in high density (Williams, 2012).

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Under stress made by high-density, growing hybrids with high yield were more tolerant than low-yield ones to crowding stress, by studying the genetic mechanism that keeps yield constant under high grow density great opportunities for future corn improvement will be possible.

Final grain yield at maturity is a basic factor used to develop crop production practices and help in breeding programs (Duvick, 2005). Providing research materials and device improvement helps people and scientists attain more data related to yield, as crop response changes to other factors rather than crop yield are so important, thus sweet corn harvested in a short time at the R3 stage (crop stages defined by (Abendroth et al., 2011) and not physiological maturity, about 72–76% of kernel moisture content is due to endosperm mutation, also sweet corn grown to fresh market or for processing (Tracy, 1993).

High quality, safe, and reliable seeds are so important to gain high yield and quality requirements, in hybrid seed production mixing of different varieties can happen during cultivation or late processes, especially in the current adoption of hybrid seed techniques. The ideal harvest time of sweet corn occurs in a short time and corn quality changes very fast after harvest (Szymanek, 2015). Cobs of sweet corn which collected at the dough stage. Biofertilizers significantly increased Stover dry weight, fresh cob weight, and plant leaf number at harvest (Wangiyana, 2021).

In sweet corn breeding programs variations in biomass yield and sugar content, and genetic traits are considered complementary traits in breeding, and benefits from corn hybrids for growers are more such as contribution as an energy source without affecting the environment and food supply (Jaime, 2015). High total sugar and low starch make corn an important crop. While recent sweet corn has had a high need for nitrogen supply to attain maximum yield compared to other corn types. Their research on sweet corn nutrition focuses on ear yield rather than seed yield (Claudemir, 2018).

An increasing seed yield and p have achieved the dose by applying 120 kg ha^{-1} nitrogen at V6, while protein content is unchanged in grains of the R400 corn variety. Seed germination and seed vigor were not affected by the date of application and rate of nitrogen, the nutrient content of sweet corn (a little decrease in P and increase in ZN) is promoted by a small amount of nitrogen application but this dose had no effect on crop physiology potential (Claudemir, 2018) sweet corn *(Zea mays* L. *saccharata)* the importance of kernel quality is very useful (Nahid, 2020). Genetic variations in yield and sugar content show that those genetic traits must be taken into consideration in crop genetic development programs (Jaime, 2015).

Hybrids of sweet corn

Recent varieties of sweet corn are characterized by lower shoot biomass and fewer tillers, in addition to its potential to use high seed density in planting, however, the prediction of PDT of a hybrid type is not accurate only by plant growth habit (Daljeet, 2021).

Canopy, plant height, and high light interception ability are the most important characteristics of sweet corn hybrids, in addition to weed tolerance (Williams et al., 2015; Zystro et al., 2012).

A study of 11 sweet corn hybrids made by (Pataky, 1992) showed that the total leaf area was between 2540 to 4660 cm^2 per plant, while (Markus, 2000) reported that tall late mature hybrid suppresses weeds better than short and early maturity varieties. (Zystro et al., 2012) studied the relationship between plant height and weed suppressing, on the other hand, (Williams et al., 2007, 2008) demonstrated that tall and high-dense canopy varieties suppress weeds and gain higher yield compared to short hybrids with low leaf area.

According to (Williams et al., 2007) wild proso millet (common weed grass in maize) shoot biomass and seed rain had a negative relation to crop leaf area index LAI) after the V6 stage (six visible leaf collars) (Williams et al., 2007). Phenomorphological traits of rapid canopy closure and a large, late-maturing canopy were positively associated with competitive ability according to the results of 23 commercial corn hybrids evaluation (So et al., 2009).

The increase of sugar and decrease in starch is a result of several endosperm mutants which became a special character of recent sweet corn kernels, which is found in the following varieties: viz, shrunken2 (sh2), brittle1 (bt1), sugary1 (su1), sugary enhancer (se), brittle2 (bt2), dull1 (du1) and waxy1(wx1) (Tracy, 2001). Those mutants had been described (Pajic et al., 2004) as enzymatic injuries in starch synthesis which delay the carbohydrate composition of endosperm, and m results in decreasing starch content, viz, sh2, bt1, su1, and se varieties are the most in increasing sugar and decreasing starch character (Lertrat and Pulam, 2007).

Sh2 and bt1 mutations accumulate more sugar at the expense of starch, and sugars are located mainly in chromosomes 3 and 5, while in su1 and se this character is located in chromosomes 4 and 2 respectively. This character works later in starch biosynthesis to participate in polysaccharide changing stored in the 10endosperm (Boyer and Shannon, 1984; Tracy, 1997). High concentrations of reducing sugars and water-soluble polysaccharides produce 3 to 10 folds more in the su1 gene at the milky stage compared to field corn and give a creamy and glossy texture with good kernel flavor (Creech, 1965; James et al., 1995; Feng et al., 2008).

Consumers favored several corn varieties globally compared to common corn types (Aziz, 2019). There are reports for the extension of the area planted by corn in China in 2018. It is estimated that about 3000 square kilometers are grown with sweet corn which consists of about 25% of the world's crop (Zhang, 2016). For the development of sweet corn planting high quality reliable, and safe seeds source is a more important issue, seed vigor can be affected by many factors. Growth and development such as climatic factors (temperature, humidity) or soil factors (nutrition, soil moisture) in addition to pests, diseases, and harvesting factors (seed drying and storage). All those factors are

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not easy to control, and their changes may lead to seed damage, and growth retardation and may lead to a loss in the final yield of the sweet corn crop.

Local sweet corn varieties contain 9–11% sugar while hybrids have a higher sugar content of between 16–18% (Znidarcic, 2012). The sugar content of kernels is the determent factor of sweet corn quality (Szymanek, 2015), and sugar content is influenced by variety and harvesting time (Abadi, 2019) and rapid harvesting of sweet corn is a crucial factor for its sweetness quality (Azanza, 1996).

The character of sugar content in sweet corn is a recessive trait controlled by mutant genes sugary 1 (su1), shrunken 2 (sh2), brittle 1 (bt1), sugary enhancer (se), and brittle 2 (bt2) These genes can work in single double or triple combinations (Singh and Langyan, 2014) those changes make changes to endosperm carbohydrates content and differ in kernel starch and sugar proportion, and are related to chromosome location (Tracy, 2001). The homozygousgous hybrid variety (super sweet) has the shrunken2 (sh2) gene (Tracy, 2001; Yousef and Juvik, 2002). Contains about 9–14% sugar content and about 15–25% endosperm accumulated sugar. This higher accumulation of sugar leads to longer harvesting time which provides slower changes of sugar to starch (Marshal & Tracy, 2003).

High zeaxanthin sweet-corn hybrids developed in Australia as natural dietary sources of zeaxanthin. The tropical super sweet-corn (Pro2) population was the source for High-zeaxanthin sweet corn, from Pro2 commercial yellow sweet-corn hybrid called Hybrix 5 was also developed. 1100% higher zeaxanthin concentrations than Hybrix 5 can be found in zeaxanthin-biofortified sweet-corn hybrids (O'Hare et al., 2014).

Most promising sweet corn hybrids G5 (SR 24 x SR 17) and G11 (SR 31 x SR 17), their stability measurement and ASV complement the AMMI and GGE bi plots in selecting stable and adaptable hybrids in terms of earliness and yield. G5 had a higher response for yield compared to Jatinangor (E1, E2), while Lembang (E3, E4), and Wanayasa (E5, E6), are better in earliness when compared to Jatinangor (E2), Lembang (E3, E4), and Wanayasa (E5, E6) (Ruswandi, 2020).

In organic corn cultivation, consideration of the growing season is so important that some varieties are inconsistent when grown in different seasons (Chozin, 2019).

In zeaxanthin-biofortified and commercial yellow sweet corn role of kernel position in total carotenoid (TC), lutein, and zeaxanthin in addition to quality parameters was evaluated. In 6 different maturity ages cobs harvested, and analysis made for kernels on above, mid, and base of cobs, results showed that in zeaxanthin biofortified sweet-corn highest lutein and TC founding kernels from the tip end, in commercial yellow sweet corn, in both highest concentration was followed by basal and middle kernels, while there were no significant differences in quality parameters according to the position of the kernel (Paula, 2019).

According to a recessive gene that controls sugar conversion to starch in the starch biosynthesis pathway in endosperm sweet corn developed naturally (Chhabra et al., 2020). Shrunken 2 variety enhances more sugar of kernels 6 times higher than field corn, thus is more favorable as the extra sweet or super sweet type of corn (Lertrat and Pulam, 2007). This variety is harvested at a milky stage when its kernels contain higher fiber, minerals, antioxidants, and vitamin B. Thus, possesses higher nutrient value compared to grain-feed corn (Lertrat and Pulam, 2007; Cabrera-Soto et al., 2018).

All three sweet corn hybrids developed well 28 DAT even with the use of herbicides, also crop yield was not affected by herbicide usage in (CNS710R and FTF246) cultivars while BSS5362 showed a decrease in yield with the application of nicosulfron or nicosulfron with bromoxynil at 2 doses, CNS7110R, and ftf246 Hybrids are classified as tolerant to nicosulfuron where BSS5362 is not tolerant to nicosulfuron (DuPont, 2003).

Fertilizer

Fertilization is the most important factor in increasing crop yield, but ideal fertilization management should be applied to show expected crop yield and preserve soil fertility (Stamatiadis, 1999; Manan, 2005; Zhang, 2009) Fertilizer has a long-term effect on soil status, kong, 2005 showed that NPK application can increase yield and improve soil fertility status for a long period, it means that residues of applied fertilizers can benefit even the next crop grown in fertilized soil, (Roberts, 2009) showed the positive impact of NPK residues, he also concludes that application of NPK as inorganic fertilizer since the 1950s increased crop yield.

P fertilizers are better for increasing the growth and yield of sweet corn compared to NPK + Mg Fertilizers, Papplication affects N, P, K, Ca, Mg, and Fe nutrients uptake in corn compared to Fertilization without P. optimum p dose for sweet corn grown on peat is about 670–890 kg hectare^{-1}. Application of this dose at these ranges results in a 13.2–13.9 t ha^{-1} yield of sweet corn (Purnomo, 2021).

Potassium (K) is a macro essential nutrient such as N and P, K application. In addition to increasing production it also improves crop quality (Zörb and Senbayram, 2014). K is essential in enzyme functioning, the photosynthesis process, and kernel formation (Mengel and Kirkby, 2001) in addition to all crop stress resistance (Zörb & Senbayram, 2014). Many reports are made of the positive role of K on growth, yield, and corn quality (Mallarino and Bergmann, 2011; Qiu et al., 2014). Thus, no sufficient data on the role of K on sweet corn grown in ultimo tropical soils.

N fertilization is important for mays plants because it accumulates in plant tissues during growth and requires only a supplementary addition by side dressing to attain a higher yield (Okumura et al., 2014). Leaf sugar content increases in corn plants with high nitrogen levels, dry weight, photosynthesis rate, and CO_2 assimilation increase in high N content plants leads

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to adequate physiological status (Jin et al., 2015). Also, some studies showed that the application of high nitrogen levels as a side dressing at vegetative or late growth stages (silking) results in increasing grain protein and improved corn nutrient content (Silva et al., 2005; Sharif and Namvar, 2016).

N fertilization is important for crop production, but the excess application may result in N loss and serious environmental damage (Lei Gao, 2020). N is considered the main limiting an important factor affecting crop yield (Ferguson, 2002).

At the seven stages, accumulation of total nitrogen and mass occur to track total nitrogen accumulation and calculate RUE. A similar pattern of measured variables occurs as in field maize, thus under favorable conditions leaf nitrogen content per unit area for sweet corn was higher than the reported nitrogen of leaves in field corn, while higher nitrogen of leaves per unit area has no effect on leaf photosynthesis rates and RUE than what reported in field maize (Nahid, 2020).

Response of sweet corn to fertilizers is observed, thus sufficient N availability during the growth phase must be taken into consideration, loss of N can happen during urea surface application and can reach about 40% nitrogen loss in the air compared to underground urea application, (Sirajuddin, 2010) research showed that there was no remarkable effect of 2 times urea application during small leaf stage but there are effects on N washing.

A reverse effect on soil can occur due to excessive nitrogen application instead of higher obtained yield, also groundwater and environmental pollution can be affected by high fertilizers use (Kumar, 2019). The efficiency of nitrogen can be reduced in high doses leading to the lodging crops together with crop susceptibility to insects and diseases, these negative effects can be solved by silicon application because the application of silicone can increase nitrogen usage efficiency, water use efficiency, cell mechanical strength together with resistance to pests and diseases and soil resilience (Rajmani, 2012). Organic production is more safe and sustainable but less productive compared to the conventional production system (Ping, 2020).

Significant increase in the p content of sweet corn leaves under the organic farming system also increases in shoot dry weight, husk ear weight, unhusked ear weight, and sweet corn yield. In addition, P uptake by corn reduces the days to harvest sweet corn (Fahrurrozi, 2019).

A closed production system as an organic agricultural practice can maintain sustainability and biodiversity together with biological cycle and soil biologic activities (Brust & Egel, 2003). In crop production, organic production can benefit crops over a long period of time and make land resources more sustainable. Usage of solid organic fertilizers in sweet corn (*Zea mays* L. *var. Saccharata*) production must also contain usage of liquid organic fertilizers (LOF) to compensate slow composition of organ fertilizers to grown crops. There are reports showing that solid organic fertilizers can take about 12 weeks to be ready for crop absorption (Foth and Ellis, 1997). Arshad et al. (2015) reported the response of sweet corn to organic fertilization, they studied different manure types for sweet corn fertilization, and results showed that organic manure residues showed a significant effect on sweet corn growth, chicken manure was the best on sweet corn growth which increased leaf number, plant height, and stem gerth compared to non-organic cattle and horse manure. Similar results were found in babies (Ojeniyi et al., 2007 and Safiullah et al., 2016) 2 studied the e effect of solid manure of different types and rates of liquid organic on yield, nutrient content, and uptake of sweet corn. According to soil fertility and pest management, practices issue organic production of sweet corn (*Zea mays var saccharata* Sturt) is still limited (Diver and Kuepper, 2001). Muktamar, (2017) detected those solid organic fertilizers have a limited effect on the yield of organic sweet corn and it must be together with liquid organic fertilizers (LOF) Previously (Fahrurrozi and Muktamar, 2016) reported that usage of (LOF) together with solid organic fertilizers did not increase sweet corn yield, on the other hand, many reports Obtained that organic fertilizers residues can increase rhizosphere nutrient content including phosphorus (Canatoy, 2018).

With the good reputation of organic agriculture and its role in food safety and quality and environmental sustainability, there is interest from farmers, producers, and consumers in organic produce (Hamzaoui, 2012).

One of the constraints is that organic sweet corn producers use seeds from varieties produced in intensive systems, sweet corn needs more soil nutrients, primary nitrogen, phosphorus, and potassium (Akintoye, 2012) requirements of crops in intensive production systems can be achieved by inorganic fertilizers application, thus it becomes challenging for organic producers as organic fertilizers are compromised mainly of animal and plant material with small macronutrients amount (Zublena, 1991).

Several organic production techniques have been developed in both field and greenhouses, those techniques include the usage of biological and organic compounds for disease and pest control (Litterick et al., 2004; Termorshuizen et al., 2006; Turemis, 2002).

Organic maize producers rely on varieties developed for the intensive farming system, and then they select varieties suitable for organic production (Chozin, 2017) increase in phosphorus uptake by sweet corn under organic production leads to increasing p content of leaf, dry weight of shoot, husk ear weight, unhusked ear weight, and yield of sweet corn. In addition, p uptake by sweet corn significantly decreased days to harvest (Fahrurrozi, 2019). Chicken manure can reduce the use of KCL fertilizer by 25%, and chicken manure compost application enhances soil health characteristics like soil respiration and microbial population (Darwin, 2020).

Most popularity and impetus in the last decades have been gained by organic farming as a result of its advantages such as the sustenance of good crop production which preserves soil health and provides safety to the environment (Ghosh, 2020).

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Plant density

Plant density can range between 9900 plants ha^{-1} as low density to 79000 plants ha^{-1} as high density with crowding stress to the plant, marketable ear mass tons ha^{-1} of average increased at a rate of 0.8 tons ha^{-1} at high density. Where plant yield (kg ha^{-1}) is unchanged over time with density change. Crate yield, a fresh market metric improved in modern hybrids (Daljeet, 2021).

Transplanting increased plant population by 34% compared to direct sowing as a result of abiotic stress, soil crusts, and low temperature negatively affects sweet corn germination and makes the reduction in plant population in direct sowing. Differences in ear yield occur due to differences in plant population and thus transplant variant had a 4.1 tons ha^{-1} higher yield in comparison to direct sowing. Also, seedling use can positively affect ear mass and length (Teofil, 2021).

Sweet corn needs about 200 kg ha^{-1} to reach high-quality ear yield (Rosen, 2017; Bundy, 2005). This fertilizer dose when compared to recommendations for field corn (*Zea mays* L.*)* sweet corn planted in relatively low plant density and harvested early as a fresh vegetable rather than grain formation stage, means 34.3% to 50% of applied nitrogen fertilizer not used by the crop, and its ability to transport outside (USDA, 2020; Kaiser, 2018; Prasad, 2016).

Irrigation

The small differences between predicted and attained sweet corn yield can occur with SPAD measuring in the range between 46–49 during tasselling. Prediction of final yield is not possible for this trait under dry conditions without irrigation but SPAT and NDVI measuring during the period of tasselling really affects kernel sugar amount Eszter, 2019) Within water deficiency 46–49 SPAD range measured within tasselling predicted 23.5–26.7 ton/hectare depends on hybrid, but the predicted yield can decrease by 6.4–10.1% during silking (Nemeskéri et al., 2019).

Irrigation system infrastructures can help in fertilizers addition in season, giving a chance to real-time adaptation and area management that may coincide with N availability according to crop demand, and reduce fertilizers leaching, this needs valid process based in addition to mechanic simulation of crop nitrogen needs and soil N cycle, amaze N model for sweet corn had been adapted, model valid for groundwater NO_3-N leaching determination in sandy soils, and assessed the potential application of this model for adaptive in-season N management in cropping system (Mingwei, 2017).

Under non-irrigated environment parameters like plant height, the weight of ear per plant, total kernels carotenoids decreased, SPAD value of leaves, normal vegetation differential index (NDVI), and LAI were low, differences in SPAD and LAI become higher between hybrids during silky stage than tasselling stage under deficit after conditions (Nemeskéri et al., 2019) Increasing food yield in arid climates within water deficiency conditions especially when rains were very scare to meet crop requirements has become a great challenge in last days due to serious shortage of water (Geerts and Raes, 2009).

In the drip system, single rows with a 225 cm water distribution system are not suitable for sweet corn growing, even with providing adequate water, the fresh yield of cob and water use efficiency significantly reduced with the increase in drip-line lateral spacing increase. Ununiformed yield with drip line lateral distance negatively affects total crop gain in single rows, thus both parameters regained in 225 cm lateral spacing with the opening of triple-row treatment (Mubarak, 2020).

Breeding of sweet corn

There are many difficulties in maize breeding due to a high number of traits that contribute to final yield, for instance, days to silking (DTS) affecting grain yield indirectly very short DTS can also shorten the growth time of maize and lead to loss of yield (Zheng et al., 2012). Also, DTS is an important character for both crossbreeding and grain yield. Also, plant height (PH), ear height (EH), and ear height ratio (ER) are factors affecting maize crop yield directly. Many researchers focused on these traits because those characteristics are also related to plant density and lodging resistance which is important to grain yield in local union (Zhang et al., 2011). Information related to GD and phenotypic variations in maize breeding are useful for new cultivars development or inbred lines process (Teng et al., 2013).

Sweet corn is distributed mainly in temperate and tropical zones, globally about one million hectares are harvested every year (USDA, 2010). Natural spontaneous mutation in endosperm kernels which approve sugar to starch conversion genes occur in field corn and result in current sweet corn varieties, a number of mutations responsible for sweet corn different types. The sugary1 (su1) mutant has been used traditionally since pre-Columbus times and contains about 5–10% sugar by weight. The shrunken2 (sh2) mutant has a high harvesting period and possesses better responses to market demands due to the replacement of the su1 variety in processing (Marshall and Tracy, 2003).

The wide range of variations in total yield and soluble sugar content suggests that all those traits should be taken into mind within breeding programs, newly developed corn varieties possess double benefits for growers and provide energy generations with ought negative effects on the food supply or environment (Jaime, 2015).

Breeders focus on grain yield in their selections and most of them propose that the best grain varieties are also the best as forage (Lee CD, 2005). Ferraretto et al., (2015) proposed that leafy corn hybrids have a significant positive effect on animals when used as silage but Darby & Lauer, 2002) showed that no hybrid differences for forage, silage, and stover yield. Some of the variances in genetic background and stage of harvest, as daily and seasonal temperature also affects corn varieties (Lee CD, 2005).

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Sowing Date

Transplanting time strongly affects plant growth and development (Hay, 1986). The sowing date can change to avoid the risk of insects and diseases in addition to adverse climatic factors leading to yield increases of crops (Harper, 1999). A lot of studies discussed the ideal sowing time for corn when the crop gets to anthesis at the ideal time, a higher temperature upper than 38 °C with water stress at anthesis time decreases fruit set under dry lands environment (Ramadoss et al., 2004). In, Herbek (1986) showed that the delay of the sowing date of corn especially in dry areas reduces yield and has a negative effect on pollination and grain filling. On the other hand, studies by (Oktem et al., 2004) resulted in the highest fresh ear yield for sowing on 25 July while the lowest yield of ears was attained when plants grew on 25 April. In Turkey determination of the optimum sowing date in dry hot areas is very critical for maximizing final yield (Abdel Rahman et al., 2002). On the other hand, sweet corn consumption, canning, and freezing should be made directly after harvesting due to the rapid change of soluble sugars to starch. Thus, the crop was planted over 3 months in the north and central us areas to maintain the availability of fresh crops for processing and marketing (Williams, 2008).

On the other hand, sweet corn should be consumed, canned, or frozen immediately after harvest as a result of the rapid conversion of soluble sugars to starch. Accordingly, sweet corn is planted over a 3-month period in the north–central United States to extend the availability of fresh produce for marketing and processing (Williams, 2008). Heat stress affects the formation of ear and kernel development in maize and can cause serious yield reduction (Dale, 1983). The optimal temperature for warm-season maize is 15–20 °C for planting and 20–30 °C during the regular growing season (Bird et al., 1977). Under field conditions, the combination of high temperatures and inadequate moisture may cause severe yield losses.

Stress

Climatic stresses such as heat, cold, drought, and salt can affect crop production negatively and cause a reduction in total yield globally, for example, high-temperature stress has far-reaching effects on crop development (Bita, 2013) facing harsh environmental changes (Chinnusamy, 2007). Regulated induction of reactive oxygen species (ROS) and membrane stability enhancement role as temperate resistant for crops (Boydston, 2015).

With increasing plant density plants can face crowding stress as a result of competition, tolerance mechanisms of plant stress can be defined as the biological process that reduces stress through response to abiotic stress like shade, water, and nutrients are important components for crowding stress tolerance, plant response to climatic stress may not at all times influence yield, some studies showed morpho changes of corn under stress conditions (Cox, 1996; Mansfield, 2014). Increases in plant processes such as nitrogen usage efficiency (McCullough, 1994), photosynthesis rate by leaves (Dwyer, 1991), and after-flowering source-sink ratio (Borras, 2001) are possible factors in the mechanism of crowding stress tolerance. Thus, the agronomic meaningful process has appositive effects on crop yield (Tardieu, 2010)

Although there is an increase in shoot height and canopy area index during crowding stress (Cox, 1996) those genetic traits are not associated with yield improvement at all times, also the development of plant processes to improve water use efficiency has a relation with a reduction in the accumulation of biomass (Tardieu, 2003; Blum, 2009).

On the other hand, traits related to yield like ear barrenness (Bunting, 1973) whereas the number of grains per cob (Baenziger, 1980; Karlen, 1985) are clear signs of crowding stress tolerance and yield. For agronomic production to identify mechanisms of stress tolerance related to yield improvement related to treats is of critical importance.

Improvement of sweet corn yield can be attained with more utilization of crowding stress tolerance; the best mechanism of crowding stress tolerance is that which affects crop yield. Several genes responsible for crowding stress tolerance had been identified through gene techniques, and mechanisms of facing tolerance had been identified, Gene expression patterns showed that each hybrid with higher yield has its own tolerance mechanism for crowding stress. Also, a network of genes related to crowding stress tolerance had been identified, especially genes related to physiological functions like photosynthesis, glycolysis, cell wall, carbohydrate/nitrogen metabolism, chromatin, and transcription regulation processes were discovered like mechanisms of crowding stress tolerance (Eunsoo, 2016).

Within heat stress genes related to cell structure maintenance, photosynthesis, signal transduction, transcription factor and response to stress with the high level of expression in the ear may be useful to understand the early development of ears and kernels, more research on those genes characters and genes without functions may lead to finding more identification of gene regulation mechanisms of heat stress (Yuliang, 2015).

Global climate change has an impact on agriculture, and it continues to change very rapidly (Oares, 2019). Water availability is a big challenge in crop growth globally, and also for development, production, and climate change caused this deficiency of water. Thus, predicting bad situations of water shortage worldwide should be taken into consideration (Raza, 2019; Xoconostle, 2010). Drought is also one important abiotic stress that can have negative effects on crop growth and development such as physical damage, physiological and biochemical disturbance, and molecular changes which lead to abnormalities of metabolic processes, reduce plant growth, leading to plant death (Hussain, 2018; Fathi, 2016).

A decrease in plant development and growth depends on drought severity, to face drought stress plant has defense mechanisms and strategies that

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contain mechanical, morphological, and biochemical modifications (Toscano, 2019).

Crowding stress tolerance within different locations plays a big role in the genetic improvement of sweet corn, results obtained from corn hybrid (era) similar studies show yield potentiality of the single plant remains constant for many years while yield per plant per unit area has increased as a result of higher population density with hybrid introduction date (Carlone and Russell, 1987; Duvick et al., 2004; Russell, 1991). Adaptation to increasing population density not only shows of relationship between density and us field corn yield over many years but also gives ideas about the future of yield improvement (Duvick, 2005; Lobell et al., 2014).

CONCLUSIONS

- A wide range of variability among hybrid maize can be exploited in the improvement of This crop.
- The application of good agricultural practices leads to a higher yield in quantity and quality.
- Environmental factors, especially temperature, are the key agents which influence plant growth and development. Environmental factors, especially temperature during seed development and maturation, might have affected yield and yield components.
- Sweet corn is an attractive crop for growers to grow as its cultural requirements are well understood, the crop grows quickly, and all operations can be fully mechanized for processing.
- By improving management and adopting innovation in areas like Integrated Pest Management on the farm, average per-hectare yields can be expected to increase Increased planting densities and improved soil management options, such as direct drilling and minimum tillage, show promise, and adoption by producers is expected to increase.
- Determination of the optimum sowing date for sweet corn is crucial for better crop yields.
- An important future research priority would be to reassess the optimal planting density for short-duration hybrids when they are being planted early. Sink and source limitations in early hybrids could be mitigated by modest increases in planting densities without compromising the stability of grain and biomass yields.

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REFERENCES

Abadi, W.; Sugiharto, N. (2019): Uji keunggulan beberapa calon varietas hibrida jagung manis (*Zea mays* L. var. saccharata) *Jurnal Produksi Tanaman, 7,* no. 5, pp. 939–948.

Abdel-Rahman, A.M.; Lazim Magboul, E. (2002): Effects of sowing date and cultivar on the yield and yield components of maize in northern Sudan. Proc. 7th Eastern and Southern Africa Regional Maize Conference, Nairobi, Kenya, 11–15 Feb. p. 295–298.

Abendroth, L.J.; Elmore, R.W. (2011): Corn Growth and Development. Iowa State University Extension, Ames, IA.

Akintoye, H.A.; Olaniyan, A.B. (2012): The yield of sweet corn in response to fertilizer sources. *Global Advan. Res. J. Agric. Sci, 1*(5): 110–116.

Alan, O.–Kinaci, G. (2014): Kernel quality of some sweet corn varieties in relation to processing. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca 42*(2):414–419. https://doi.org/10.1583/nbha4229425.

An, M.; Pratley, J.E.; Haig, T. (2001): Phytotoxicity of Vulpia Residues: III. Biological Activity of Identified Allelochemicals from *Vulpia myuros*. *J Chem Ecol 27,* 383–394. https://doi.org/10.1023/A:1005640708047.

Arshad, A.M.; Rawayau, H.W. (2015): The potential impact of different organic manure sources and Arbuscular Mycorrhizal Fungal Inoculation on growth performance of sweet corn grown on BRIS soil. *International Journal of Development and Sustainability, 6* (8), 641–649.

Asthir, B. (2015): Protective mechanisms of heat tolerance in crop plants. *J Plant Interact 10:*202–210.

Azanza, F.– Klein, B. P. (1996): Sensory characterization of sweet corn lines differing in physical and chemical composition, Journal of Food Science, vol. 61, no. 1, pp. 253–257.

Aziz, M.M.; Nawaz, R. (2019): Starch composition, antioxidant potential, and glycemic indices of various *Triticum aesitivum* L. and *Zea mays* L. varieties are available in Pakistan. *J. Food Biochem., 43,* e12943. [CrossRef].

Baenziger, P.S.; Glover, D.V. (1980): Effect of reducing plant population on yield and kernel characteristics of Sugary-2 and normal maize. *Crop Sci.; 20*: 444–447.

Barbieri, V.H.B.; Luz, J.M.Q. (2005): Produtividade e rendimento industrial de híbridos de milho doce em função de espaçamento populações de plantas. *Horticultura Brasileira, 23,* 826–830.

Barros-Rios, J.; Romaní, A.; Garrote, G.; Ordás, B.J. (2015): Biomass, sugar, and bioethanol potential of sweet corn. *GCB Bioenergy 7,* 153–160, doi 10.1111/gcbb.12136.

Becker, H.C.; Leon, J. (1988): Stability analysis in plant breeding. *Plant Breeding 101*:1–23.

Bird, I.F.; Cornelius, M.J. (1977): Effects of temperature on photosynthesis by maize and wheat. *J. Exp. Bot. 28,* 519–524.

Bita, C.E.; Gerats, T. (2013): Plant tolerance to high temperature in a changing environment: scientific fundamentals and production of heat-stress-tolerant crops. *Front Plant Sci. 4:*273.

Blum, A. (2009): Effective use of water (EUW) and not water-use efficiency (WUE) is the target of crop yield improvement under drought stress. *Field Crops Res.; 112*: 119–123.

Borras, L.; Otegui, M.E. (2001): Maize kernel weight response to post-flowering source-sink ratio. Crop Sci. 41: 1816–1822.

Boydston, R.A.; Williams, M.M. (2015): Sweet corn hybrid tolerance to weed competition under three weed management levels. *Renewable Agriculture and Food Systems: 31*(4); 281–287. DOI:10.1017/S1742170515000204

DOI: 10.34101/ACTAAGRAR/1/12830

Boyer, C.; Shannon, J.C. (1984): The use of endosperm genes for sweet corn improvement. In: Janick, J. (ed) *Plant breeding reviews*, vol 1. Wiley, Hoboken, pp 139–161.

Brust, G.; Egel, D.S. (2003): Organic vegetable production. Purdue University Extension Publication ID-316. Retrieved from https://www.extension.purdue.edu/extmedia/ID/ ID_316.pdf.

Budak, F.; Aydemir, S.K. (2018): Grain yield and nutritional values of sweet corn (*Zea mays var. saccharata*) in produced with good agricultural implementation. *Nutrition and Food Science International Journal* *7*(2):1–5. https://doi.org/10.19080/NFSIJ.2018.07.555710.

Bundy, L.G.; Andraski, T.W. (2005): Recovery of Fertilizer Nitrogen in Crop Residues and Cover Crops on an Irrigated Sandy Soil. *Soil Sci. Soc. Am. J. 69*, 640–648. [CrossRef].

Bunting, E.S. (1973): Plant density and yield of grain maize in England. *J Agric Sci.; 81*: 455–46.

Cabrera-Soto, L.; Pixley, K.V. (2018): Carotenoid and chromanol profiles during kernel development make consumption of biofortified “fresh” maize an option to improve micronutrient nutrition. *J Agric Food Chem. 66*:9391–9398.

Calvo-Brenes, P.; Fanning, K.; O'Hare, T. (2019): Does kernel position on the cob affect zeaxanthin, lutein, and total carotenoid contents or quality parameters, in zeaxanthin-biofortified sweetcorn. *Food Chemistry. 277*. 490–495.

Canatoy, R.C. (2018): Dry matter and NPK uptake of sweet corn as influenced by fertilizer application. *Asian J. Soil Sci. & Plant Nutr. 3*. 1–10.

Carlone, M.; Russell, W.A. (1987): Response to plant densities and nitrogen levels for four maize cultivars from different eras of breeding. *Crop Sci. 27*, 465–470.

Chhabra, R.; Hossain F. (2019): Mapping and validation of Anthocyanin1 pigmentation gene for its effectiveness in the early selection of shrunken2 gene governing kernel sweetness in maize. *J Cereal Sci 87*:258–265.

Chhabra, R.; Hossain, F. (2020): Development and validation of gene-based markers for shrunken2-Reference allele and their utilization in marker-assisted sweet corn (*Zea mays* Sachharata) breeding program. *Plant Breed. 139:*1135–1144.

Chiang, H.C. (1973): Bionomics of the northern and western corn rootworms. *Annu. Rev. Entomol. 18*, 47–72. https://doi.org/10.1146/annurev.en.18.010173.000403.

Chinnusamy, V.; Zhu, J.; Zhu, J.K. (2007): Cold stress regulation of gene expression in plants. *Trends Plant Sci 12:*444–451.

Chozin, M.; Sudjatmiko, S.; Muktamar, Z.; Setyowati, N.; Fahrurrozi, F. (2019): 6th International Conference on Sustainable Agriculture, Food and Energy IOP Conf. Series: *Earth and Environmental Science 347.* 012007 IOP Publishing doi:10.1088/1755-1315/347/1/012007.

Cox, W.J. (1996): Whole-plant physiological and yield responses of maize to plant density. *Agron J; 88*: 489–496.

Creech, R.G. (1965): Genetic control of carbohydrate synthesis in maize. *Genetics 52*:1175–1186.

Culy, M.D.–Edwards, C.R. (1992): Minimum Silk Length for Optimum Pollination in Seed Corn Production Fields. *Journal of Production and Agricultural. 5*, issue 3, 295–413.

Dale, R.F. (1983): Temperature perturbations in the Midwestern and Southeastern United States important for corn production. In: C. D. Raper, and P. J. Kramer (eds), *Crop Reactions to Water and Temperature Stresses in Humid Temperature Climates*, Westview Press, Boulder, CO, USA. 21–32.

Darby, H.M.; Lauer, J.G. (2002): Harvest date and hybrid influence on yield, quality, and preservation of corn forage yield. *Agron J. 94:* 559–66.

Darwin, H.P.; Sarno, Y.L. (2020): Effects of Chicken Compost and KCl Fertilizer on Growth, Yield, Post-Harvest Quality of Sweet Corn, and Soil Health. *AGRIVITA Journal of Agricultural Science. 42*(1): 131–142.

Datta, D.; Chandra, S. (2019): Yield and quality of sweet corn under varying irrigation regimes, sowing methods, and moisture conservation practices. *J. Pharmacogn. Phytochem. 8*, 1185–1188.

Demirel, R.; Fatih, A. (2011): The determination of qualities in different whole-plant silages among hybrid maize cultivars. Afr *J Agric Res; 6:* 5469–74.

Dhaliwal, D.S.; Ainsworth, E.A.; Williams, M.M. (2021): Historical Trends in Sweet Corn Plant Density Tolerance Using Era Hybrids (1930–the 2010s) *Front. Plant Sci., 22*. September 2021 https://doi.org/10.3389/fpls.2021.707852.

Dia, M.; Wehner, T.C.; Hassell, R. (2016): Genotype Environment interaction and stability analysis for watermelon fruit yield in the United States. *Crop Sci. 56*:1645–1661.

Diacono, M.; Montemurro, F. (2010): Long-term effects of organic amendments on soil fertility. A review. *Agron. Sustain. Dev, 30*, 401–422. [CrossRef].

Diver, S.; Kuepper, G. (2001): Organic sweet corn production. ATTRA Cooperative Service USDA. 28 pages.

Division of Extension University of Wisconsin-Madison, (2014): Methods for Determining corn pollination success. URL http://corn.agronomy.wisc.edu/Management/L018. aspx. (Accessed May 2020).

Dupont. (2003): Accent® 75 DF herbicide. 25116- 20030731-F2 E Label. Dupont Canada Inc. 13.

Duvick, D. (2005): The contribution of breeding to yield advances in maize (*Zea mays* L.). *Adv. Agron. 86*, 83–145.

Duvick, D.N. (1997): What is a yield. In Edmeades GO, Bänziger B, Mickelson HR, Pena-Valdivia CB, Editors. *Developing drought and low N-tolerant maize*. Mexico: CIMMYT, El Batan. pp. 332–335.

Duvick, D.N. (2005): Genetic progress in yield of United States maize (*Zea mays* L.). *Maydica.; 50*: 193– 202.

Duvick, D.; Smith, J.S. (2004): Long-term selection in a commercial hybrid maize breeding program. In: Janick, J. (Ed.), *Plant Breeding Reviews*. Wiley, New York, pp. 109–151.

Dwyer, L.M.; Tollenaar, M. (1991): Changes in plant-density dependence of leaf photosynthesis of maize (*Zea mays* L) hybrids, 1959 to 1988. *Can J Plant Sci.; 71*: 1–11.

El-Hamed, K.; Elwan, M. (2012): Enhanced sweet corn propagation: Studies on transplanting feasibility and seed priming. *Vegetable Crops Research Bulletin 75*:31–50. https://doi.org/10.2478/v10032-011-0016-4.

El-Sawah, A.M.; Ali, D.F.I. (2020): The integration of bio and organic fertilizers improves plant growth, grain yield, quality, and metabolism of hybrid maize (*Zea mays* L.) *Agronomy, 10*, 319. [CrossRef].

Eunsoo, C. (2016): Identification of Crowding Stress Tolerance Co-Expression Networks Involved in Sweet Corn Yield. *PLOS ONE* | DOI:10.1371/journal.pone.0147418.

Fahrurrozi, (2019): Phosphorus Uptakes and Yields of Sweet Corn Grown Under Organic Production System. 6th International Conference on Sustainable Agriculture, Food and Energy IOP Conf. Series: Earth and Environmental Science 347 012006 IOP Publishing doi:10.1088/1755-1315/347/1/012006.

DOI: 10.34101/ACTAAGRAR/1/12830

Fahrurrozi, M. (2016): Growth and yield responses of three sweet corn (*Zea mays* L. var. saccharate) varieties to local-based liquid organic fertilizer. *Int. J. Adv. Sci. Eng. Inform. Tech. 6*. 319–23.

Fathi, A.; Tari, D.B. (2016): Effect of drought stress and its mechanisms in plants. *Int J Life Sci., 10*(1):1–6.

Feng, Z.L.; Liu, J. (2008): Molecular mechanism of sweet and waxy in maize. *Int J Plant Breed Genet 2*:93–100.

Ferguson, R.B.; Hergert, G. (2002): Site-specific nitrogen management of irrigated maize. *Soil Sci. Soc. 66*, 544–553.

Ferraretto, L.F.; Fonseca, A.C. (2015): Effect of corn silage hybrids differing in starch and neutral detergent fiber digestibility on lactation performance and total-tract nutrient digestibility by dairy cows. *J Dairy Sc; 98*:395–405.

Foth, H.D.; Ellis, B.G. (1997): Soil fertility (2nd ed.). Boca Raton: CRC Press.

Gao, L.; Li, W.; Ashraf, U.; Lu, W.; Li, Y.; Li, C.; Li, G.; Li, G.; Hu, J. (2020): Nitrogen Fertilizer Management and Maize Straw Return Modulate Yield and Nitrogen Balance in Sweet Corn. *Agronomy, 10*, 362; doi:10.3390/agronomy10030362.

Gavrić, T.; Omerbegovic, O. (2021): Effect of transplanting and direct sowing on productive properties and earliness of sweet corn. *Chilean journal of agricultural research 81*(1) January-March 2021.

Geerts, S.; Raes, D. (2009): Deficit irrigation as an on-farm strategy to maximize crop water productivity in dry areas. *Agricultural Water Management, 96*. 1275–1284.

Ghimire, S.; Scheenstra, E.; Miles, C.A. (2020): Soil-biodegradable Mulches for Growth, Yield, and Quality of Sweet Corn in a Mediterranean-type Climat. *Hortscience 55*(3):317–325. https://doi.org/10.21273/HORTSCI14667-19.

Ghosh, D.; Brahmachari, K. (2020): Nutrient supplementation through organic manures influences the growth of weeds and maize productivity. *Molecules 25*:4924. https://doi.org/10.3390/molecules25214924.

Hammad, H.M.; Ahmad, A. (2011): Optimizing water and nitrogen use for maize production under semiarid conditions. *Pak. J. Bot. 43*.2919–2923.

Hamzaoui-Essoussi, L.; Zahaf, M. (2012): The organic food market: Opportunities and challenges. In *Organic Food and Agriculture-New Trends and Developments in the Social Sciences*, Ed. Reed M. (Rijeka, Croatia: InTech) p 63–88.

Harper, F. (1999): *Principles of arable crop production*. Blackwell Science, London, UK.

Hassell, R.L.; Dufault, R.J. (2003): Low-temperature germination response of su, se, and sh2 sweet corn cultivars. *HortTechnology 13*(1):136–141. https://doi.org/10.21273/horttech.13.1.0136.

Hay, R.K.M. (1986): Sowing date and the relationships between plant and apex development in winter cereals. *Field Crops Res. 14*:321–337.

Herbek, H. (1986): Tillage system and date of planting effects on yields of corn on soils with restricted drainage. *Agron. J. 78*:824–826.

Heshemi, N.; Seyed, M. (2017): The effects of drought and heat stress on some physiological and agronomic characteristics of new hybrids of corn in the north of Khuzestan Province (Iran). *EurAsian Journal of BioSciences 11*:32–36.

Hussain, H.A.–Hussain, S. (2018): Chilling and drought stresses in crop plants: implications, cross talk, and potential management opportunities. *Front Plant Sci., 9*(April):1–21.

James, M.G.; Robertson, D.S. (1995): Characterization of the maize gene sugary1, a determinant of starch composition in kernels. *Plant Cell, 7*:417–429.

Jin, X. et al. (2015): Effects of nitrogen stress on the photosynthetic CO_2 assimilation, chlorophyll fluorescence, and sugar-nitrogen ratio in corn. *Scientific Reports, London, 5,* s/n. 1–9.

Kaiser, D.; Fernandez, F. (2018): Fertilizing Corn in Minnesota; the University of Minnesota Extension: Saint Paul, MN, USA.

Karlen, D.L.; Camp, C.R. (1985): Row spacing, plant-population, and water management effects on corn in the Atlantic coastal plain. *Agron J.; 77:* 393–398.

Kong, H. M.; He, Y.Q. (2004): Effect of Long-Term Fertilization on Crop Yield and Soil Fertility of Upland Red Soil. *Chinese Journal of Applied Ecology, 15*, 782–786.

Krawiec, D.; Hunek, A. (2018): The use of physical factors for seed quality improvement of horticultural plants. *J. Hort. Res., 26*, 81–94. [CrossRef].

Kumar, A.; Pramanick, B. (2019): Growth, yield, and quality improvement of flax (*Linum usitattisimum* L.) grown under tarai region of Uttarakhand, India through integrated nutrient management practices. *Ind Crop Prod 140*:111710. https://doi.org/10.1016/j.indcrop.2019.111710 8.

Kwiatkowski, A.; Clemente, E. (2007): Características do milho doce (*Zea mays* L.) para industrialização. *Revista Brasileira de Tecnologia Agroindustrial 1*: 93–103.

Lee, C.D.; Lacefield, G. (2005): Producing corn for silage [Internet]. University of Kentucky Cooperative Extension Service; 2005 [cited 2018 Feb 23]. Available from: http://www2.ca.ukyedu/agcomm/pubs/agr/agr79/agr79.pd.

Lertrat, K.; Pulam, T. (2007): Breeding for increased sweetness in sweet corn. *Int J Plant Breed 28*:27–30.

Li, Y.; Hu, J.; Liu, J.; Suo, H.; Yu, Y.; Han, F. (2015): Genome-wide analysis of gene expression profiles during early ear development of sweet corn under heat stress. *Plant Breeding, 134,* 17–27 https://doi.org/10.1111/pbr.12235 © 2014 Blackwell Verlag GmbH.

Litterick, A.M.; Harrier, L.; Wallace, P.; Watson, C.A.; Wood, M. (2004): The role of uncomposted materials, composts, manures, and compost extracts in reducing pest and disease incidence and severity in sustainable temperate agricultural and horticultural crop production- a review. *Plant Sci. 23*:453-479.

Lobell, D.B.; Roberts, M. (2014): Greater sensitivity to drought accompanies maize yield increase in the U.S. Midwest. *Science 344*, 516–519.

Lu'quez, J.E.; Aguirrez, L.A.N. (2002): Stability and adaptability of cultivars in non-balanced yield trials: Comparison of methods for selecting 'high oleic' sunflower hybrids for grain yield and quality. *J. Agron. Crop Sci. 188*:225–234.

Makus, D. (2000): Performance of two sweet cultivars grown under conservation tillage and with-in-row weed pressure. *Subtropical Plant Science, 52*:18–22.

Mallarino, A.P.; Bergmann, N. (2011): Corn responses to in-furrow phosphorus and potassium starter fertilizer applications. *Agronomy Journal, 103*(3), 685–694 https://doi. org/10.2134/agronj2010.0377

Manan, M.C.; Swarup, A. (2005): Long-term effect of Fertilizer and Manure Application on Soil Organic Carbon Storage, Soil Quality and Yield Sustainability Under Sub-Humid and Semi-Arid Tropical India. *Filed Crops Research, 93*: 264-280.

Mansfield, B.D.; Mumm, R.H. (2014): Survey of plant density tolerance in US maize germplasm. *Crop Sci.; 54:* 157–173.

Marshall S.W.; Tracy, W.F. (2003): Sweet corn. In: *Corn: Chemistry and Technology*, 2nd edn (eds White PJ, Johnson LA), American Association of Cereal Chemists Inc., St. Paul, Minnesota, USA. pp. 537–569.

DOI: 10.34101/ACTAAGRAR/1/12830

Marshall, S.W.; Tracy, W.F. (2003): Sweet corn. In: White, P. J.; Johnson, L. A. (Ed.). *Corn: chemistry and technology*. 2. ed. Saint Paul: American Association of Cereal Chemists. p. 537–569.

Mengel, K.; Kirkby, E.A. (2001): *Principles of plant nutrition* (5th ed.) Dordrecht, Netherlands: Springer. https://doi.org/10.1007/978-94-010- 1009-2.114.

Mingwei, Y. (2017): Adaption of the AmaizeN model for nitrogen management in sweet corn (*Zea mays* L.). *Field Crops Research 209*. 27–38.

Mohammed, Y.A.C.; Chen, K. (2016): Yield performance and stability of dry pea and lentil genotypes in semi-arid cereal dominated cropping systems. *Field Crops Res. 188*:31–40.

Mubarak, I. (2020): Triple-row system with a wider drip-line lateral spacing for two drip-irrigated sweet corn cultivars. *Pesq. Agro pec. bras., 55*, e01684, DOI: 10.1590/S1678-3921.pab2020.v55.01684.

Muchtar, A.N.W.; Andi, I (2020): The effect of fertilizing residues on growth and yield of sweet corn. ICFST 2019 IOP Conf. Series: Earth and Environmental Science 484 (2020) 012078 IOP Publishing doi:10.1088/1755-1315/484/1/012078.

Muktamar, Z.; Fahrurrozi, F. (2016): Selected macronutrient uptake by sweet corn under different rates of liquid organic fertilizer in Closed Agriculture System. *Int. J. Adv. Sci. Eng. Inform. Tech. 6*, 258-61.

Muktamar, Z.; Sudjatmiko, S. (2017): Sweet Corn Performance and Its Major Nutrient Uptake Following Application of Vermicompost Supplemented with Liquid Organic Fertilizer Int. *J. Adv. Sci. Eng. Inform. Tech. 7*, 602-8.

Nahid, J.; Deepti, P. (2010): Basis of limited-transpiration rate under elevated vapor pressure deficit and high temperature among sweet corn cultivars. *Environmental and Experimental Botany 179* (2020) 104205.

Nahid, J.; Deepti, P. (2020): Sweet corn nitrogen accumulation, leaf photosynthesis rate, and radiation use efficiency under variable nitrogen fertility and irrigation. *Field Crops Research, 257*, 15 October 2020, 107913.

Nemeskéri, E.; Molnár, K.; Rácz, C.; Dobos, A.C.; Helyes, L. (2019): Effect of Water Supply on Spectral Traits and Their Relationship with the Productivity of Sweet Corn. *Agronomy, 63*; doi:10.3390/agronomy9020063.

Nordby, J.N.; Williams, M.M. (2008): A common genetic basis in sweet corn inbred Cr1 for cross-sensitivity to multiple cytochrome P450-metabolized herbicides. *Weed Sci. 56*:376–382.

Oares, J.C.; Santos, C.S. (2019): Preserving the nutritional quality of crop plants under a changing climate: importance and strategies. *Plant Soil.; 443*(1–2):1–26.

O'Hare, T.J.; Martin, I. (2014)**:** Sweetcorn color change, and consumer perception associated with increasing zeaxanthin for the amelioration of age-related macular degeneration. 10.17660/ActaHortic.2014.1040.30.

Ojeniyi, S.O.; Akanni, D.I.; Awodun, M.A. (2007): Effect of goat manure on some soil properties and growth, yield, and nutrient status of tomato (Lycopersicon lycopersicum). *University of Khartoum Journal of Agricultural Sciences, 15*, 396–405.

Oktem, A.; Oktem, A.G. (2004): Determination of sowing dates of sweet corn (*Zea mays* L. saccharata Sturt.) under Sanliurfa conditions. *Turk. J. Agr. For. 28*:83–91.

Okumura, R.S. et al. (2014): Effects of nitrogen rates and timing of nitrogen topdressing applications on the nutritional and agronomic traits of sweet corn. *Journal of Food, Agriculture, and Environment*, Helsinki, *12*, n. 2, p. 391–398.

Pajic, Z.; Dukanovic, L. (2004): Effects of endosperm mutants on maize seed germination. *Genetika, 36*(3):265–270.

Pareja-Sánchez, E.; Cantero-Martínez, C. (2020): Impact of tillage and N fertilization rate on soil N_2O emissions in irrigated maize in a Mediterranean agroecosystem. *Agric. Ecosyst. Environ., 287*. [CrossRef].

Pataky, J.K. (1992): Relationships between the yield of sweet corn and northern leaf blight caused by *Exserohilum turcicum*. *Phytopathology, 82*:370–375.

Pataky, J.K.- M.M. Williams, (2011): Observations from a quarter century of evaluating reactions of sweet corn hybrids to disease nurseries. Plant Dis. 95:1492–1506.

Ping, F.H.; Yao, T.C. (2020): Long-Term Effects of Fertilizers with Regional Climate Variability on Yield Trends of Sweet Corn. *Sustainability, 12*, 3528; doi:10.3390/su12093528.

Prasad, R.; Hochmuth, G.J. (2016): Environmental Nitrogen Losses from Commercial Crop Production Systems in the Suwannee River Basin of Florida. *PLoS ONE, 11*, e0167558. [CrossRef].

Purnomo, J.; Subiksa, I.G.M. (2021): Effect of P fertilizer formula on the growth and yield of sweet corn on peatland. 1st International Conference on Sustainable Tropical Land Management IOP Conf. Series: Earth and Environmental Science 648 (2021) 012194 IOP Publishing doi:10.1088/1755-1315/648/1/012194.

Qi, X.; Zhao, Y.; Jiang, L.; Cui, Y. (2009): QTL analysis of kernel soluble sugar content in super-sweet corn. *African Journal of Biotechnology, 8*: 6913-6917.

Qiu, S.; Xie, J. (2014): Long-term effects of potassium fertilization on yield, efficiency, and soil fertility status in a rain-fed maize system in northeast China. *Field Crops Research, 163*, 1–9. https:// doi.org/10.1016/j.fcr.2014.04.016.

Rajmani, K. (2012): Effect of Silica on Rice (*Oryza sativa* L.) yield and its uptake under different levels of nitrogen application. Ph.D. A thesis submitted to Acharya N. G. Ranga Agricultural University. Hyderabad, India.

Ramadoss, M.; Birch, C.J.; Carberr, P.S. (2004): Water and high-temperature stress effects on maize production. In: Fischer et al. *New Directions for a Diverse Planet: Proc* 4th International Crop Science Congress. Brisbane, Australia, 26 Sept. to 1 Oct.

Rattin, J.; Molinari, J. (2018): Tools for improving sweet corn yield. *International Journal of Advances in Agriculture Sciences 3*(10):1–14.

Raza, A.; Razzaq, A. (2019): Impact of climate change on crops adaptation and strategies to tackle its outcome: a review. *Plants.;8*(2):34.

Robertson, G.P.; Vitousek, P.M. (2009): Nitrogen in Agriculture: Balancing The Cost of An Essential Resource. *Annual Review of Environment and Resources,* 34: 97–125.

Rosa, R. (2015): Quality of sweet corn yield depending on winter catch crops and weed control method. *Acta Sci. Pol. Hortorum Cultu, 14*, 59–74.

Rosen, C.J.; Crants, J. (2017): Establishing Nitrogen Credits Following a Sweet Corn Crop; Minnesota Department of Agricultural Grant Report: Saint Paul, MN, USA.

Ruswandi, D.; Yuwarian, Y. (2020): Stability and Adaptability of Yield among Earliness Sweet Corn Hybrids in West Java, Indonesia.

Safiullah, K.; Durani, A.; Durrani, H. (2018): Influence of different rates of solid manure and types of liquid organics on yield, nutrient content, and uptake of sweet corn under South Gujarat

DOI: 10.34101/ACTAAGRAR/1/12830

condition. *International Journal of Chemical Studies, 6* (2), 3304- 3310.

Santos, P.H.A.D.; Pereira, M.G.; Trindade, R. dos S.; Cunha, K.S. da; Entringer, G.C.; Vettorazzi, C.F. (2014): Agronomic performance of super-sweet corn genotypes in the north of Rio de Janeiro. *Crop Breeding and Applied Biotechnology 14*: 8–14. Brazilian Society of Plant Breeding. Printed in Brazil.

Schroeder, J.W. (2013): Corn silage management [Internet]. North Dakota State University Extension Service; 2013 [cited 2018 Feb 23]. Available from: https://www.ag.ndsu.edu/pubs/ansci/dairy/as1253.pdf.

Sharifi, R.S.; Namvar, A. (2016): Effects of time and rate of nitrogen application on phenology and some agronomical traits of maize (*Zea mays* L.) Biologija, *Gedimino, 62*, n. 1, p. 35–45.

Silva, P.R.F. (2005): Grain yield and kernel crude protein content increases of maize hybrids with late nitrogen side-dressing. *Scientia Agricola, Piracicaba, 62*, n. 5, p. 487–492, 2005.

Singh, I.; Langyan, S. (2014): Sweet corn, and corn-based sweeteners. *Sugar Tech, 16*, p. 144–14.

Sirajuddin, M.; Lasmin, S.A. (2010): Response Growth and yield of sweet corn (*Zea mays* saccharata S.) at various times of administration of Nitrogen fertilizer and thickness of straw mulch. *Agroland Journal*, *17*: 184–191. (in Indonesia).

So, Y.F.; Williams, M.M. II.; Pataky, J.K. (2009): Principal canopy factors of sweet corn and relationships to competitive ability with wild-proso millet (*Panicum illicium). Weed Sci. 57*:296–303.

Spike, B.P.; Tollefson, J.J. (1989): Relationship of root ratings, root size, and root regrowth to yield of corn injured by western corn rootworm (Coleoptera: Chrysomelidae). J. Econ. *Entomol. 82*, 1760–1763. https://doi.org/10.1093/jee/ 82.6.1760.

Stamatiadis, S.; Werner, M. (1999): Field Assessment of Soil Quality as Affected by Compost and Fertilizer Application in A Broccoli Field (San Benito County, California). *Applied Soil Ecology. 12*: 271-225.

Subaedah, S.; Edy, E. (2021): Growth, Yield, and Sugar Content of Different Varieties of Sweet Corn and Harvest Time. *Hindawi International Journal of Agronomy, Volume 2021*, Article ID 8882140, 7 pages https://doi.org/10.1155/2021/8882140.

Surtinah, S. (2020): Increasing Sweet Corn Production: Fertilizing *Zea Mays Saccharata*, Sturt Context in Pekanbaru. Indonesia. International Conference on Environment and Technology IOP Conf. Series: Earth and Environmental Science 469 012114.

Szymanek, M. (2009): Influence of sweet corn harvest date on kernel quality. *Research in Agricultural Engineering 55*(1):10–17 DOI 10.17221/13/2008-RAE.

Szymanek, M.B.; Dobrzañski, J. (2005): Sweetcorn, Harvest and Technology, Physical Properties and Quality. Centre of Excellence Agrophysics for Applied Physics in Sustainable Agriculture; B. Dobrzański Institute of Agrophysics of Polish Academy of Sciences, Poland, pp:234.

Szymanek, M.; Tana´s, W. (2015): Kernel Carbohydrates Concentration in Sugary-1, Sugary Enhanced and Shrunken Sweet Corn Kernels. *Agric. Agric. Sci. Procedia, 7,* 260–264. [CrossRef].

Tabakovic, M.; Simic, M. (2020): Effects of shape and size of hybrid maize seed on germination and vigor of different 159-genotypes. *Chilean Journal of Agricultural Research 80*:381–392. https://doi:10.4067/S0718-58392020000300381.

Tardieu, F. (2003): Virtual plants: modeling as a tool for the genomics of tolerance to water deficit. *Trends Plant Sci.; 8*: 9–14. PMID: 12523994.

Tardieu, F.; Tuberosa, R. (2010): Dissection and modeling of abiotic stress tolerance in plants. *Curr Opin Plant Biol.; 13*: 206–212. doi 10.1016/j.pbi.2009.12.012 PMID: 20097596.

Teixeira, F.F.; Sousa, I.R. (2001): Avaliação da capacidade de combinação entre linhagens de milho doce. *Ciência e Agrotecnologia 25*: 483- 488.

Teng, F.; Zhai, L. (2013): ZmGA3ox2, a candidate gene for a major QTL, qPH3.1, for plant height in maize. *Plant J 73*(3):405–416.

Termorshuizen, A.J.; van Rijn, E. et al. (2006): Suppressiveness of 18 composts against 17 pathosystems: variability in pathogen response. *Soil Biol. Biochem. 38:*2461–2477.

Thomas, R.; George, K. (1991): Global warming: Evidence for asymmetric diurnal temperature change. *Geophys. Res. Lett., 18*, 2253–2256.

Tollenaar, M.; Lee, E.A. (2002): Yield potential, yield stability, and stress tolerance in maize. *Field Crops Res.; 75*: 161–169.

Toscano, S.; Ferrante, A.; Romano, D. (2019): Response of Mediterranean ornamental plants to drought stress. *Horticulture.; 5*(1):1–20.

Tracy, W. (1993): Sweet corn, *Zea Mays* L. In Kalloo, G., Bergh, B.O. (Eds.), *Genetic improvement of vegetable crops*. Pergamon Press, Oxford, pp. 777–807.

Tracy, W.F. (2001): Sweet corn. In: Hallauer AR (ed) *Specialty corns*, 2nd. CRC Press, Boca Raton, pp 155–197.

Tracy, W.F.; Whitt, S.R. (2006): Recurrent mutation and genome evolution: example of Sugary1 and the origin of sweet maize. *Crop Science, 46*: 1–7.

Turemis, N. (2002): The effects of different organic deposits on yield and quality of strawberry cultivar Dorit (216). *Acta Hort. 567*:507–510.

Ugur, A.; Maden, H.A. (2015): Sowing and planting period on yield and ear quality of sweet corn (*Zea mays* L. var. *saccharata*) Ciência *Agrotecnologia* *39*(1):48–57. https://doi.org/10.1590/s1413-70542015000100006.

USDA (2010): US Sweet corn statistics. Economic Research Service (ERS), US Department of Agriculture. Available at: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1564 (accessed 1 September 2013).

USDA-Nass. (2020): United States Department of Agriculture, CropScape—National Agricultural Statistics Service Crop Data Layer Program. Available online: https://nassgeodata.gmu.edu/CropScape/ (accessed on 2 January 2020).

Wangiyana, W.; Farida, N. (2021): Effect of peanut intercropping and mycorrhiza in increasing yield of sweet corn yield. IOP Conf. Series: Earth and Environmental Science 648 -012068 -Western corn rootworm (Coleoptera, Chrysomelidae) on yield and quality of inbred corn in seed corn production fields. *J. Econ. Entomol. 85* (6), 2440–2446. https://doi.org/10.1093/jee/85.6.2440.

William, M. (2014): Better sweet corn research, better production. ACES.College of Agricultural, Consumer and Environmental SciencesACES News and Public Affairs. University of Illinois, Urbana, Illinois, USA. http://www.uiuc.edu.

Williams, II. M.M. (2012): Agronomics and economics of plant population density on processing sweet corn. *Field Crops Res. 128*:55–61.

Williams, M. M., II. (2017): Genotype Adoption in Processing Sweet Corn Relates to Stability in Case Production. *HortScience 52*(12):1748–1754. 2017. doi: 10.21273/HORTSCI12595-17.

DOI: 10.34101/ACTAAGRAR/1/12830

Williams, M.M. (2008): Sweet corn growth and yield responses to planting dates of the North Central United States. *HortScience 43*(6):1775–1779.

Williams, M.M. (2010): Biological significance of low weed population densities on sweet corn. *Agron. J., 102,* 464–468. [CrossRef].

Williams, M.M. II. (2008): Sweet corn growth and yield responses to planting dates of the north-central United States. *HortScience 43*:1775– 1779.

Williams, M.M. II.; Boydston, R.A. (2006): Canopy variation among three sweet corn hybrids and implications for light competition. *HortScience 41*:1449– 1454.

Williams, M.M. II.; Boydston, R.A. (2007): Wild proso millet (*Panicum miliaceum*) suppressive ability among three sweet corn hybrids. *Weed Science 55*:245–251.

Williams, M.M. II.; Boydston, R.A.; Davis, A.S. (2008): differential tolerance in sweet corn to wild-proso millet (*Panicum miliaceum*) interference. *Weed Science 56*: 91–96.

Williams, M.M.II. (2015): Identifying crowding stress-tolerant hybrids in processing sweet corn. *Agron J.; 107:* 1782–1788.

Xoconostle-Cazares, B.; Ramirez-Ortega, F.A.; Flores-Elenes, L.; Ruiz-Medrano, R. (2010): Drought tolerance in crop plants. *Am J Plant Physiol.; 5*(5):241–56.

Yousef, G.G.; Juvik, J.A. (2002): Enhancement of seedling emergence in sweet corn by marker-assisted backcrossing of beneficial QTL. *Crop Science, 42,* p. 96–104.

Yuliang, L.; Jianguang, H.; Jianhua, L. (2015): Genome-wide analysis of gene expression profiles during early ear development of sweet corn under heat stress https://doi.org/10.1111/pbr.12235.

Zhang, J.J.; Qin, W. (2009): Effect of Long–Long-term application of Manure and Mineral Fertilizers on Nitrogen Mineralization and Microbial Biomass Paddy Soil During Rice Growth Stages. *Plant Soil Environment 55* (3): 101–109.

Zhang, R.F.; Huang, L. (2016): Phenolic content, and antioxidant activity of eight representative sweet corn varieties grown in South China. *Int. J. Food Prop, 20,* 3043–3055. [CrossRef].

Zhang, Y.; Li, Y.; Wang, Y.; Peng, B. (2011): Correlations and QTL detection in maize family per se and testcross progenies for plant height and ear height. *Plant Breed, 130*:617–624.

Zheng, Z.P.-Liu, X.H. (2012): QTLs for days to silking in a recombinant inbred line maize population subjected to high and low nitrogen regimes. *Genet Mol Res, 11*(2):790–798.

Znidarcic, D. (2012): Performance and characterization of five sweet corn cultivars as influenced by soil properties, *Journal of Food Agriculture and Environment, 10,* no. 1, pp. 495–500.

Zörb, C.; Senbayram, M.; Peiter, E. (2014): Potassium in agriculture - Status and perspectives. *Journal of Plant Physiology, 171*(9), 656–669. https:// doi.org/10.1016/j.jplph.2013.08.008.

Zublena, J.P.; Baird, J.V. (1991): Nutrient content of fertilizer and organic materials. N.C. Coop. Ext. Serv. Soil Facts. AG-439-18. North Carolina State University (USA).

Zucareli, C.; Bizzarri Bazzo, J.H.; Silva, J.B.; Santiago Costa, D.; Batista Fonseca, I.C. (2018): Nitrogen rates and side-dressing timing on sweet corn seed production and physiological potential. *Rev. Caatinga, Mossoró, 31,* n. 2, p. 344–351.

Zystro, J.P.; de Leon, N. (2012): Analysis of traits related to weed competitiveness in sweet corn (*Zea mays* L.). Sustainability 4:543–560.