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Performance of Sweet Corn under Different Fertility Levels - A Review

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A B S T R A C T

In recent time, sweet corn (*Zea mays* L.) is gaining popularity as a healthy snack item, both in urban & rural areas due to its high sugar and low starch content. There are diversified reports regarding effect of plant nutrients on growth and yield of sweet corn. Application of fertilizer considerably improves various yield attributes such as number of ears per plant, number of kernel per cob and kernel weight due to promotion of physiological activities in the plant. Sweet corn production is more influenced by nitrogen as compared with other nutrients. Depending upon location, cultivar and season of cultivation; sweet corn responds up to 150:75:50 kg $N:P_2O_5:K_2O$/ha to obtain more yield of green cob and green fodder. Fertilizer management affects the quality of sweet corn through variation in content of protein, sugar and starch in the grain. The maximum net profit was recorded up to a fertility level of 150:50:60 kg $N:P_2O_5:K_2O$/ha.

Introduction

Corn (*Zea mays* L.) is a versatile crop, which is broadly used for human food, animal feed, fodder and industrial raw material. Recently, the specialty corns such as baby corn and sweet corn have emerged as alternate food products for human consumption. Sweet corn has become one of the most popular and economically important crops in the world (Akinrinde and Teboh, 2006). Sweet corn is gaining popularity both in rural and urban areas because of its high sugar and low starch content (Game *et al*., 2017).

Among various crop management practices, nutrient application plays an important role in determining the quality and yield of sweet corn. The growth and yield of sweet corn are very much influenced by application of various plant nutrients. Compared with other crops, sweet corn has adequate potentiality of converting plant nutrients into economic parts. Sweet corn is a heavy feeder requiring

high amount of nitrogen, phosphorus and potassium (Ortas and Sari, 2003). The yield of sweet corn is very much affected when the soil is deficient in plant nutrients. Pangaribuan *et al.,* (2018) from Indonesia opined that low production of sweet corn is largely influenced by low soil fertility.

There are diversified reports regarding effect of plant nutrients on growth and yield of sweet corn. Enhanced application of various nutrients stimulates efficient absorption of plant nutrients and their translocation. Besides, nutrients help in better utilization of incident solar radiation, enhanced carbon dioxide assimilation and promotion of photosynthetic activities, which ultimately helps in production of assimilates in the plant (Kumar *et al*., 2007; Jaliya *et al*., 2008; Asghar *et al*., 2010 and Uwah *et al*., 2011). An attempt has been made to review the available literature on the effect of plant nutrients, especially nitrogen, phosphorus and potassium on yield, quality and economics of sweet corn.

Growth and development

Balanced application of plant nutrients has positive effect on growth and development of sweet corn. Increasedrate of NPK application increases biomass production through efficient utilization of solar radiation resulting in enhanced photosynthesis. Kumar *et al.,* (2007) observed increase in leaf area index and dry matter accumulation in sweet corn with enhanced level of NPK application. However, the quantity of nutrient requirement varies depending on soil fertility, growing season, cultivar used and management practices. Higher rate of fertilizer application promoted better growth across the cultivars and resulted in higher uptake of nitrogen, phosphorus and potassium (Akpan and Udoh, 2017).

Nitrogen is the key element for efficient growth and development of plants. Precise management of nitrogen is very much important to obtain higher yield while maintaining soil health. Nitrogen requirement of sweet corn varies depending on various biotic and abiotic factors such as soil status, climatic features, varietal characteristics, water availability and management options. Inherent availability of nitrogen in the soil has considerable effect on growth of root and vegetative parts of the plant. Bavec *et al*., (2015) recorded deeper root system in sweet corn crop grown under low nitrogen status. Availability of nitrogen also influences the utilization of solar energy by the crop. Sonbai *et al.,* (2013) opined that increased absorption of inorganic nitrogen fertilizer enhances production of more chlorophyll in plant, which helps in utilizing more solar energy for production of carbohydrates. Several researchers have studied about the effect of nitrogen on growth and development of sweet corn. At Pantnagar, there was increase in leaf area index with increase in nitrogen level up to 120 kg/ha (Shivay and Singh, 2000). Whereas, increase in nitrogen level up to 180 kg/ha increased the number of green leaves per plant (Singh *et al.,* 2003), which was ultimately responsible for enhanced dry matter production. Pangaribuan *et al.,* (2018) from Indonesia recorded higher concentration of nitrogen in plants with application of higher quantity of nitrogen through urea.

Phosphorus and potassium also play a crucial role for growth of root and above ground plant parts of sweet corn. Massey and Gaur (2006) reported higher growth attributes like plant height, leaves per plant and leaf area with application of 90 kg N and 45 kg P_2O_5/ha. Under Gujrat situation, Dangariya *et al.,* (2017) recorded the highest values of plant height, stem diameter and number of leaves per plant with application of 150 kg N and 75 kg P_2O_5/ha. Singh *et al.,* (2019) from

Pantnagar reported that application of 100% RDF(120 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha) resulted in the tallest plants (134.5 cm) and maximum dry matter accumulation (82.1 g/plant), although it was statistically comparable with application of 125 % RDF.

Yield attributes

Yield of sweet corn is utterly influenced by various yield attributing factors such as plant stand, number of ears per plant, number of kernel per cob and kernel weight. Application of plant nutrient has a direct bearing on various yield attributing characters. Increase in application of fertilizer considerably improves various yield attributes due to promotion of physiological activities in sweet corn. Jaliya *et al*., (2008) recorded more number of grains/cob and higher grain weight with application of150:26:50 kg NPK/ha. Akhtar and Silva (1999) obtained more weight of fresh ears with enhanced quantity of nitrogen application up to150 kg N/ha. Increase in nitrogen application upto 120 kg/ha enhanced various yield attributing factors such as cob count per unit area, no. of kernel/cob, weight of green cob & kernel and kernel recovery (Singh *et al*., 2012). On the other hand, stress condition created by deficient supply of various nutrients adversely affects the yield attributing factors. Sahoo and Mahapatra (2007) from Odisha reported more number of barren plants (28.2%), lighter cobs (84 g) with less number of small kernels (144/cob) in absence of fertilizer application. Pangaribuan *et al.,* (2018) opined that sweet corn production is more affected by nitrogen deficiency as compared to other nutrients.

Besides nitrogen, phosphorus and potassium fertilization also influences performance of yield attributes of sweet corn. Grazia *et al.,* (2003) reported that phosphorus application increased ear diameter and bio-mass production of sweet corn. Singh *et al.,* (2003) reported that increase in potassium level up to 60 kg/ha increased the number of cobs per unit area, length &girth of cob and test weight of grain. Many workers have reported that combine application of nitrogen, phosphorus and potassium positively affected the yield attributing characters of sweet corn. Dangariya *et al.,* (2017) obtained longer, thicker and heavier cobs with application of 150 kg N and 75 kg P_2O_5/ha, may be due to better availability of photosynthates, metabolites and nutrients to develop reproductive structures. Under Hyderabad situation, Shanti *et al.,* (2012) recorded more girth ofcob (12.43 cm) and longer cobs (15.83 cm) with application of 150:75:45 kg N:P_2O_5:K_2O/ha.Under Pantnagar situation, 125% RDF produced the longest cob (19.5 cm) and heaviest cob (196 g), which was statistically comparable with 100% RDF(120 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha)(Singh *et al*., 2019). Similar findings were reported by Sunitha and Reddy (2012) from Tirupati, who reported that increase in nutrient level up to 150:70:50 kg N:P_2O_5:K_2O /ha increased the number of kernels/cob and green cob weight. However, it was statistically at par with the nutrient level of @180:80:55 kg N:P_2O_5:K_2O/ha.

Yield

The role of major nutrients is very much crucial for deciding yield of sweet corn. Several researchers have reported significant contribution of nitrogen, phosphorous and potassium to obtain expected yield from the crop. Nitrogen plays a key role in deciding the production level of sweet corn due to its contribution in the biological functions in plant system (Akintoye and Olaniyan, 2012). Nitrogen augments better plant growth, particularly enhancement of leaf area and root system by affecting cell division and cell expansion (Efthimiadou *et al.,* 2009). In sweet corn, nitrogen management is a big challenge

as the crop requires comparatively large quantity of the nutrient for growth and yield. The yield and yield parameters of sweet corn are largely influenced by the rate of nitrogen application. Singh *et al.,* (2012) recommended application of 120 kg nitrogen/ha to obtain maximum green cob yield from sweet corn.

Adequate availability of phosphorus and potassium is necessary to obtain expected yield from sweet corn. Sharma *et al.,* (2000) observed that response of P increased with corresponding increase in N levels. Arya and Singh (2001) recorded the highest grain and stover yield with application of 40 kg P/ha. Significant increase in yield of green cob and green fodder was recorded by Massey and Gaur (2013) with application of 90 kg N and 45 kg P_2O_5/ha. Dangariya *et al.,* (2017) recorded maximum green cob yield (8.10 t/ha) with application of 120 kg N and 60 kg P_2O_5/ha. But, Geleta *et al.,* (2004) did not find any effect of applied phosphorus on yield of sweet corn under high soil P status.

Several researchers have worked on coalesce application of N,P and K to get maximum yield of sweet corn. Kumar and Chawla (2018) from Ludhiana obtained maximum green cob yield of 11.41 t/ha with application of 150:50:60 kg N:P_2O_5:K_2O/ha.Thorat *et al*., (2016) advocated application of 150:75:50 kg N:P_2O_5:K_2O/ha to obtain higher values of yield attributes resulting in more yield of green cob and green fodder. Similar findings were also reported by Sunitha and Reddy (2012) under Tirupati situation, who obtained the maximum yield of green cob and fodder with application of 150:70:50 kg N:P_2O_5:K_2O/ha.Under rainfed situation during kharif season, Sahoo and Mahapatra (2008) reported maximum green cob yield (12.04 t/ha) with application of 80:40:40 kg N:P_2O_5:K_2O/ha.Singh *et al.,* (2019) recorded maximum yield of husked (17.1 t/ha) and dehusked (12.3 t/ha) cob with fertilizer application at 125% RDF. But, it was statistically at par with application of 100% RDF (120 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha).

Various authors have worked on combine application of chemical fertilizer and organic manure for better yield and good quality of sweet corn production. Kaur *et al.,* (2019) recorded the maximum green cob yield (22.24 t/ha) with application of nutrients through 75% RDF and 25% N through vermi-compost. Under Dapoli situation, Shetye *et al.,* (2019) also recorded maximum yield of green cob with husk (22.69 t/ha) and green fodder (26.19 t/ha) with application of 75% RDN through chemical fertilizer and 25% RDN through vermi-compost. Under Odisha situation, Rao *et al.,* (2020) obtained the maximum yield from sweet corn with application of 120:60:60 kg N:P_2O_5:K_2O/ha and bio-fertilizer consortia (*Azotobactor*+ *Azosporillum*+ posphobacter) @15 kg/ha.

Quality

The market value of sweet corn is determined by the quality of harvest. The quality of sweet corn is decided by the contents of protein, sugar and starch in the kernel. Different workers have observed variation in contents of kernel due to variation in availability of plant nutrients. Capon *et al*., (2017) reported that protein, sugar and starch content of sweet corn is influenced by variation in fertilizer management. The protein content of sweet corn increased with increased level of fertilizer due to higher nitrogen uptake by the plant. Pangaribuan *et al.,* (2017) reported better quality of grains with higher sucrose content with application of 150 kg N/ha. Sunitha and Reddy (2012) recorded highest protein content (13.87%) in kernels with application of 180:80:55 kg N:P_2O_5:K_2O/ha. Being the principal constituent of proteins,

nitrogen might have substantially increased the protein content of kernels with increased uptake of nitrogen under higher nutrient levels (Raja, 2001).

Many researchers have recorded better quality of sweet corn when nutrients are supplied through organic and inorganic sources. Kaur *et al.,* (2019) observed the maximum protein content (14.85%) in grain with application of 75% of RDF along with 2.5 t/ha vermi-compost. This may be attributed to better physiological and bio-chemical activity under adequate and balanced nutrient supply.

Economics

Economics of cultivation varies depending on local situation, season of cultivation and management practices. Kumar and Chawla (2018) from Ludhiana recorded highest net return of Rs. 31073/ha and B:C ratio of 1.69 with application of 150:50:60 kg $N:P_2O_5:K_2O$/ha.Singh *et al.,* (2019) obtained the maximum net return (Rs. 133858/ha) with application of 125% NPK, which was statistically at par with 100% NPK (120 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha).Sahoo and Mahapatra (2007) also recorded the maximum net profit of Rs. 45084/ha with application of 120:60:60 kg $N:P_2O_5:K_2O$/ha. Sunitha and Reddy (2012) recorded the highest benefit-cost ratio of 3.43 with application of 150:70:50 kg $N:P_2O_5:K_2O$/ha, although it was statistically at par with 180:80:55 kg $N:P_2O_5:K_2O$/ha.Rao *et al.,* (2020) recorded the highest net return of Rs164206/ha and benefit-cost ratio of 1.92 with application of 120:60:60 kg N, $P_2O_5$and K_2O/haalong with bio-fertilizer consortia (*Azotobactor*+ *Azosporillum*+ posphobacter) @15 kg/ha.

Application of NPK is vital for obtaining better plant growth and higher yield of good quality sweet corn. Depending on soil status, growing situation and varietal characteristics; fertilizer management can be optimally decided to obtain profitable yield of sweet corn.

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