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Review: "Influence of Macro Nutrients on Plant Yield of Sunflower (*Helianthus annuus*L.)"

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Abstract

Sunflower (*Helianthus annuus*L.) is an important crop ranks fourth next to soybean, groundnut and rape seed in total production of oilseeds of the world. It has been recognized as a crop with high potentials that can successfully meet future oil requirements of the country. The lower productivity of sunflower is mainly due to insufficient supply of nutrients, non-adoption of proper crop rotation and weed management practices and also continuous use of inorganic fertilizer deteriorates soil health and also which makes soil unproductive for next season. Formulation of macronutrients (MN) based fertilizer, in terms of application rate and method, and uptake of MN by sunflower has the ability not only to ensure nutrients availability to plants particularly in MN limiting environments but also can manipulate the environmental hazards associated with over inorganic fertilization. To support this view, clear experimental evidence is still lacking. In addition, the current review aimed to brief the influence of MN on yield and yield components of sunflower cultivars/hybrids.

Key words: Sunflower, Macronutrients, Yield and Yield attributes.

Introduction

Sunflower (*Helianthus annuus* L.) is an important oilseed crop in India. It ranks third next to groundnut and soybean in crop production. In India, sunflower has recently established as a potential oilseed crop of economic importance. Intensive agriculture with fertilizer use highly skewed towards nitrogen, has deprived the soil of other essential nutrients, especially P and K. Application of nitrogenous, phosphatic and potassic fertilizer at sub optimal level adversely affects the yield.

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1.1 Effect of Nitrogen Levels

Nitrogen is the most common limiting factor for yield as it tends to reduce oil percentage in seeds, change the amino acid balance and increase leaf area. Managing nitrogen fertilization is of importance as its deficiency reduces vegetative and generative growth, there by potentially reducing yields (Amjed *et al*., 2013). High N availability may shift the balance towards excessive vegetative development, thus delays crop maturity and reduces seed yield (Kunzova E *et al*., 2007).

1.1.1 Yield Attributes and Yield

During 2011, Awasthi and his coworkers reported that yield attributes, notably 1000-seed weight of sunflower increased progressively with increase in nitrogen level up to 120 kg ha^{-1}. This may be ascribed to the overall improvement in crop vigour and production of sufficient photosynthates owing to higher availability of nitrogen.

Hussain and Thomas (2010) reported significant increase in the seed yield of sunflower with nitrogen application up to 120 kg ha^{-1}, however 80 and 120 kg N ha^{-1}were statistically similar. Nitrogen doses of 40, 80 and 120 kg ha^{-1}increased the seed yield by 30.13, 55.77 and 56.73 %, respectively over the control treatment. Aglave*et al*. (2009) reported significant increase in the head diameter and 1000-seed weight in sunflower with nitrogen application at 30 kg ha^{-1} over control. The nitrogen levels of 30, 60 and 90 kg N ha^{-1} did not differ significantly.

Sarkar and Mallick (2009) obtained significantly higher seed yield in sunflower fertilized with 120 kg N ha^{-1} with yield superiority of 90 and 20 percent over control and 60 kg N ha^{-1} respectively. The oil content of sunflower significantly decreased from 37.8 to 34.8 per cent with increase in nitrogen application from 0 to 120 kg ha-1. The capitulum size, seeds $capitulum^{-1}$ and 1000-seed weight which could be due to synthesis of more photosynthates that might have resulted in better partitioning of photosynthates in yield attributes.

Gudade *et al.* (2009) reported significant decrease in the oil content in sunflower with increase in fertility level up to 150 per cent (120 kg N + 90 kg P_2O_5 + 00 kg K_2O ha^{-1}) whereas the oil yield recorded significant and consistent increase with increase in fertility level up to 150 per cent. Working under Germany conditions during 2008, Abbadi and his coworkers observed that achene yield in sunflower responded strongly to the N-application. Increased achene yield was recorded with application of nitrogen at 2.0 g pot^{-1}.

Al-Thabet (2006) reported significant increase in the seed yield of sunflower from 1.874 to 4.131 t ha^{-1} with increase in nitrogen application from 0 to 200 kg N ha^{-1}. The seed yields recorded with 50, 100 and 150 kg N ha^{-1} were 2.620, 3.478 and 3.953 tha^{-1}, respectively. Working under Bangladesh conditions, Jahangir *et al.* (2006) recorded maximum head diameter in sunflower at fertility level of 120 kg N Kg ha^{-1} and maximum number of seeds per head (339.8) with 120 kg N ha^{-1}. Significantly higher seed yield of 2.08 t ha^{-1} with fertilizer level of 120 kg N ha^{-1}.

Syed *et al.* (2006) reported a significant increase in seed and stalk yield in sunflower from 9.31 to 14.61 q ha^{-1} and 21.35 to 40.07 kg ha^{-1} with increase in nitrogen application from 0 to 80 kg N ha^{-1}, respectively. Shah and Khanday (2005) reported that during their two years of investigation carried out on sunflower there was significant improvement in head diameter, number of seeds per head and seed weight per head with increase in nitrogen application up to 90 kg ha^{-1}. However, filled seeds per head and 1000-seed weight recorded significant and consistent improvement with increase in nitrogen application only up to 60 kg ha^{-1}.

Ozer *et al.* (2004) reported that nitrogen application at 60 kg ha^{-1}recorded significantly higher head diameter (20.7 cm) and 1000-seed weight (65.02 g) in sunflower compared to control. With the increase in nitrogen application up to 160 kg N ha^{-1} recorded significantly higher seed yield in sunflower which was 30 percent more than realized with control.

Thavaprakash and Kumar (2003) stated that capitulum diameter of sunflower increasing with increased NPK ratios and significantly highest (20.73 cm) capitulum diameter was obtained by the application of NPK in the ratio of 2.00: 1.00: 1.00 (120: 60: 60 kg NPK/ha), N with or without K soil or foliar application at 60 kg N and 40 kg K_2O/ha. Nandhagopal*et al*. (2003a) reported that fertilizer application of 75: 105 NP kg ha^{-1} produced the highest seed yield of 2030 kg ha^{-1} in sunflower. Nawaz and his coworkers (2003) recorded maximum seed yield in sunflower fertilized with 120-90-60 kg NPK ha^{-1} and the lowest seed yield was obtained with control. Sivamurugan *et al.* (2003) concluded that for realizing significantly higher seed yield (1540 kg ha^{-1}) in sunflower, the crop need to be fertilized with N @ 80 kg ha^{-1} compared to seed yield of 1508 kg ha^{-1} realized with N @ 70 kg ha^{-1}.

Reddy *et al*. (2002) reported that dry matter accumulation per plant in sunflower crop increased up to 40 kg N ha^{-1} and it was on par with 60 kg N. However, the increase in the nitrogen from 40 kg ha^{-1} to 80 kg N ha^{-1}did not

show any marked difference in capitulum diameter. Taha*et al*. (2001) reported that the diameter of capitulum of sunflower was significantly highest (14.6 cm) when fertilizer nitrogen applied at the rate of 90 kg ha^{-1} and it was significantly superior over 60 kg N ha^{-1}.

Upadhyay*et al*. (2001) reported that the application of N fertilizers improved head diameter significantly (17.9 cm) with increase in levels from 0 to 80 kg N ha^{-1}. It was observed by Nayak*et al*. (2001) that nitrogen application up to 60 kg ha^{-1}in sunflower significantly increased the seed weight/plant and further increase in N up to 90 kgha^{-1} had no beneficial effect.

Akbar (2000) observed that application of 75 kg N $acre^{-1}$ recorded maximum number of grains $plant^{-1}$ in sunflower (291.76), Whereas the minimum number of grains $plant^{-1}$ (218.76) were recorded with 9.37 kg N $acre^{-1}$. The yield per plant increased linearly up to 90 kg each nitrogen and phosphorus per ha and there after decreased slightly as observed by Jat and Giri (2000).

1.2 Effect of Phosphorous Levels:

Phosphorus (P) seems to be an important constraint in bumper harvest of the crop in most of the sunflower growing areas which are deficient in phosphorus by boosting up production, rapid and vigorous start to plants strengthens straw and decreases lodging tendency. It also improves the crop quality and resistance against plant diseases (Aliet *et al*., 2004).

1.2.1 Yield Attributes and Yield

Adebayo *et al*. (2010) reported that the P could increase yield of sunflower especially when the P level in the soil is sub optimal. Flower diameter was significantly ($P<0.05$) affected by P levels, its value increased from 11.36 cm to 14.40 cm by increasing P levels up to 60 kg P ha^{-1} with highest flower diameter of 20.24 cm during 60 DAS. Head weight values increased significantly from 188.3 g to 257.1g with the application of 0 kg P ha^{-1} (control) to 30 kg P ha^{-1}. Generally, flower diameter, head weight and 100seed weight increased significantly with P application compared to the control (0 kg P ha^{-1}). But overall, 30 kg P ha^{-1} recorded the highest head weight (296.7 g) and 100 seed weight (6.07 g).

With increase in phosphorus application in sunflower, seed yield increased up to 120 kg P ha^{-1} (Reddy *et al*., 2003). Patel and Thakur (2003) observed that application of phosphorus at 80 kg ha^{-1} recorded maximum seed yield (29 g /plant). Farid and his coworkers (2000) also recommended higher doses for sunflower production and reported that application of 120 kg P_2O_5 ha^{-1} gave the highest yield of 1249.2 kg ha^{-1} of sunflower seed while control plots only

yielded 384.3 kg ha^{-1}.

1.3 Effect of Potassium

Potassium (K), one of the three primary nutrients, is absorbed by plants in larger quantities than any other element. It maintains turgor pressure of cell which is essential for cell expansion. It helps in osmo-regulation of plant cell, assists in opening and closing of stomata.

1.3.1 Yield Attributes and Yield

Faisal *et al.* (2013) reported that maximum seed number (861) seeds/head was observed on plants of sunflower that were treated with K @ 120 Kg ha^{-1}, whereas minimum value (589) seed/head was observed on plants that treated with control treatment. Nawaz *et al.* (2003) revealed significant increase in head diameter with increase in nutrient dose up to 60 kg K ha^{-1}, further increase in K levels up to 180 K ha^{-1} showed the decrease in the capitulum diameter. Maximum 1000 Seed weight (77) gm was observed on plants that treated with (6000 mg K L^{-1} Foliar spray) treatment, whereas minimum value (48.5) gm was observed on plants that treated with (3000 mg K L^{-1} Foliar spray) treatment. Maximum seed yield (4.36) t ha^{-1} was observed on plants that were treated with (120 kg K. ha^{-1}) which was superior to all the other treatments, whereas minimum value (2.30) tha^{-1} was observed on plants that treated with control (30 kg K .ha^{-1} soil + 9000 mg K .L^{-1} Foliar spray).

Conclusion

Higher yield parameters *viz*. seed yield and stalk yield can be obtained by application of macro nutrients and also had impact on the yield parameters significantly as compared to control treatment. Higher head diameter is known to allow a large number of seeds successively increase the yield. So, application of macro nutrients produced significantly higher number of seeds over control. Better translocation of nutrients from source to sink enabling better growth and yield parameters and finally the seed yield of crop.

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