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INTEGRATED FOLIAR FERTILIZER EFFECTS ON GROWTH AND YIELD OF SUNFLOWER

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ABSTRACT

Sunflower (*Helianthus annuus* L.) has been found responsive to foliar application of macro and micronutrients. Potential of foliar application of nitrogen (N), zinc (Zn) and boron (B) alone and in combination for improving growth and yield of sunflower (cv. HO-1) was evaluated under field conditions. The experiment was laid out in a Randomized Complete Block Design having a net plot size of 4x5 (20 m^2). Foliar fertilizer treatments included in the study were: NPK (recommended rates through soil) (T_1), Foliar application of N (T_2), Foliar application of Zn (T_3), Foliar application of B (T_4), Foliar application of N and Zn (T_5), Foliar application of N and B (T_6), Foliar application of Zn and B (T_7), and Foliar application of N, Zn and B (T_8). Nitrogen was applied through Urea (@ 1%); whereas Zn (Chelated 6% Zn) and B (Kera Stop 5% Boron) were applied @ 1.25 L ha^{-1} and 2.5 L ha^{-1}, respectively. It is evident from the results that integrating N, Zn and B (T8) for foliar application remained most effective treatment for increasing height, number of leaves, stem girth, head diameter, seeds per head, seed weight per head, seed index and seed yield of sunflower.

Keywords: boron, foliar application, nitrogen, sunflower, seed yield, zinc

INTRODUCTION

Foliar application of plant nutrients has become an effective way to increase the yield and quality of field crops (Moradi *et al.,* 2018). In arid and semi-arid regions, foliar application of nutrition is a more suited option compared to soil application when the roots are unable to provide necessary nutrients (Ehmke, 2018). Various other advantages are quick compensation of nutrient deficiency and application of lesser rates and thus, reducing the degree of toxicity arises from excessive piling up of elements and protecting against nutrients fixation in the soil (Oad *et al.,* 2018). Incorporation of sufficient fertilizers will augment plant nutrient uptake and their balance in the soil which eventually escalate crop yields. Absorption of adequate fertilizers will increase plant nutrient uptake and their stability in the soil which ultimately will increase crops yield (Abdulraheem *et al.,* 2018). Multi-nutrient foliar fertilization, in relation to balanced plant nourishment, appeared to be the business and parcel of modern sustainable crop development during the recent past. This kind of mode of applying fertilizers to the crops has been considered as an essential product to the usage of nutrients to soil system (Furtado and Haves*,* 2018). Sunflower is quite responsive to micronutrients (Jyothi *et al*., 2018). Among the micronutrients, zinc insufficiency is most common on a broad array of soils (Candan *et al*., 2018; Diovisalvi *et al.,* 2018; Jaksomsak *et al*., 2018). The optimum fertilization ensures satisfactory crop production, better plant nutrient concentrations and soil nutrient status (Abdulraheem *et al*., 2018). Reproductive phase of sunflower is much susceptible to lower boron application as compared to the vegetative phase (Dhillon *et al*., 2018). This paper reports the findings of the study conducted to assess the impact of foliar application of nitrogen, zinc and boron either alone or in combination on growth and yield of sunflower under field environment.

MATERIALS AND METHODS

A field experiment was conducted to assess the effect of sole and integrated foliarly applied fertilizers on growth and yield of sunflower. The experiment was laid out in a Randomized Complete Block Design (RCBD) with net plot size of 4x5 (20 m^2) at Students Farm, Department of Agronomy, Sindh Agriculture University, Tandojam. Recommended land preparation practices were adopted for

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sunflower plantation. The most common local variety HO-1 was selected and included in this study. The experiment had three replications and following eight foliar fertilizer application treatments: NPK (recommended rates through soil) (T_1), Foliar application of N (T_2), Foliar application of Zn (T_3), Foliar application of B (T_4), Foliar application of N and Zn (T_5), Foliar application of N and B (T_6), Foliar application of Zn and B (T_7), and Foliar application of N, Zn and B (T_8). In each treatment nitrogen was applied through spraying 1% urea solution, Zn was applied by spraying 1.25 L ha^{-1} of chelated zinc solution (Elément Chelated 6% Zn) and boron was applied through spraying 2.5 L ha^{-1} using Kera Stop with 5% boron. At maturity 15 plants were harvested from each experimental unit to measure height (cm), number of leaves per plant and stem girth (cm). The disks were separated from each plant and threshed to count number of seeds $head^{-1}$ and record seed weight $head^{-1}$, 1000-seed wight (seed index) and seed yield.

Statistical analysis

The data were subjected to ANOVA using MSTAT-C statistical package. The LSD test was applied to compare means superiority, where ever necessary (Russel and Eisensmith, 1983).

RESULTS

The foliar application of nitrogen, zinc and boron showed significant (P<0.05) and positive impact on physiological, yield and yield component traits of sunflower (Table 1). Compared to the sole spray of nitrogen (T_2), zinc (T_3) and boron (T_4), the plants sprayed with nitrogen + zinc (T_5); nitrogen + boron (T_6), zinc + boron (T_7) and nitrogen + zinc + boron (T_8) grew taller in height, produced more leaves; showed significant increase in stem girth (cm), head diameter (cm), number of seeds per head, seed weight per head, seed index (1000-seed weight) and seed yield per hectare. As compared to unsprayed, the plants sprayed with N + Zn and B in T_8 showed 16% increase in height, had 40% more leaves, displayed 40, 63, 53, 56, 53 and 36% increase in stem girth, head diameter, number of seeds $head^{-1}$, seed weight $plant^{-1}$, seed index and seed yield ha^{-1}, respectively.

DISCUSSION

Foliar feedling of sunflower plants was found to be very much effective particularly in improving the physiological and yield traits. Foliar application of nitrogen combined with zinc and boron (T_8) was found to be more effective for foliar spray. This suugests that sunflower plants uptake some nutrients immediately after application; especially nitrogen, zinc and boron, as we applied in this study. In order to meet the fertilizer requirement of crops the soil application of nutrients can be escaped, where several issues related to availability and solubility of nutrients exist and plants mainly become unable to uptake nutrients from soil. Generally, leaching and volatile losses to nitrogen (Oad *et al*., 2018), fixation of zinc in soil with calcium carbonate, bicarbonates, etc. have long been reported in arid and semi-arid region soils (Candan *et al*., 2018; Jaksomask *et al*., 2018; Khan *et al.,* 2018).

Like zinc the boron has also been reported as one of the most critical micronutrients required by sunflower crop (IFA, 1992). Application of boron to crops particularly contributes to a sustain increase in seed yield, possibly due to prolonged photosynthetic capacity throughout flowering and fruiting (Oad *et al.,* 2018).

Positive impact of foliar application of nitrogen combined with zinc and boron was possibly due to the development of root system, immediate uptake of applied elements through leaves, activation of various digestive supporting enzymes related to chemical processes and various physical techniques (Adam and lwona, 2018). The immediate and economic response of the crop to the applied nutrients complements the nutritional requirement, independent of the adverse soil condition (Shah *et al.,* 2018). It is very much clear from our results and the reports presented by Anon. (2015) and Asad *et al*. (2018) that foliar application of boron can be used to supply crops when boron demand is higher than soil supply boron. In this study, integrating nitrogen with boron and zinc for foliar spray enhanced sunflower growth and yield significantly. The economic response of sunflower plants receiving in the shape of higher yield was associated with change in head diameter, number of seeds per head and 1000-seed weight as well. Generally we can assume from this study that foliar application of micronutrinets alongwith nitrogen plays an important role particularly in improving seed yield of field crops. Praveen *et al.* (2018) also supports our conclusions by showing significant improvement in the yield components due to foliar application of borax (0.1%) to sunflower crop for hybrid seed production.

Table 1. Agronomic traits of sunflower as affected by sole and integrated foliar application of fertilizers

Treatments	Plant height (cm)	No. of leaves plant^{-1}	Stem girth (cm)	Head diameter (cm)	Number of seeds head^{-1}	Seed weight (g head^{-1})	Seed index (g)	Seed yield (kg ha^{-1})
Control (No foliar fertilizer)	156.0c	26.38b	7.443c	16.08d	426.7e	26.08d	41.07d	1640c
Foliar nitrogen @ 1.0%	161.0bc	30.74ab	10.09b	18.80cd	523.3d	29.42cd	50.75c	1829bc
Foliar zinc (Element chelated 6% @ 1.25 l ha^{-1})	174.3a	35.93a	11.98a	23.52ab	616.0ab	37.00ab	60.94ab	2224a
Foliar boron (Kera Stop 5% @ 2.50 l ha^{-1})	176.0a	33.33ab	11.02ab	22.46bc	591.7abc	35.16abc	55.16bc	1978abc
Foliar nitrogen @ 1.0% + foliar zinc (Element chelated 6% @ 1.25 l ha^{-1})	169.0ab	31.89ab	11.15ab	20.07bc	578.3bcd	35.01abc	53.12c	1938abc
Foliar nitrogen @ 1.0% + foliar boron (Kera stop 5% @ 2.50 l ha^{-1})	172.0ab	35.96a	12.07a	23.04ab	614.7ab	36.27ab	60.14ab	2110ab
Foliar Zinc (Element Chelated 6% @ 1.25 l ha^{-1}) + foliar boron (Kera stop 5% @ 2.50 l ha^{-1})	150.3c	29.58ab	10.08b	21.27bc	532.3cd	32.77bc	50.76 c	1993abc
Foliar nitrogen @ 1.0% + foliar zinc (Element chelated 6% @ 1.25 L ha^{-1}) + foliar boron (Kera stop 5% @ 2.50 l ha^{-1})	180.7a	36.83a	12.34a	26.25a	651.0a	40.76a	62.65a	2228a
S.E	3.926	2.166	0.4435	1.133	20.02	1.952	2.080	106.1
LSD (0.05)	11.91	6.570	1.345	3.437	60.74	5.921	6.309	290.09
CV%	4.06	11.51	6.76	9.16	6.12	9.93	6.630	9.230

Means with the same letter(s) are not significantly different at (*P* = 0.05*)* level.

CONCLUSION

It is concluded that combined foliar application of nitrogen, zinc, and boron was the optimal treatment for maximum plant growth and seed yield of sunflower crop.

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