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Response of Sunflower to B5A (foliar fertilizer) at Gezira, Rahad and New Halfa, Sudan

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ABSTRACT: A field experiment was conducted in season 2018/2019 across the Agricultural Research Corporation (ARC) at three experimental sites: Gezira, New Halfa and Rahad to investigate the effect of B5A liquid on the yield and yield components of sunflower. Seven treatments were adopted: **1 –** Control or check (Zero fertilizer), **2** – Application of the recommended fertilizer dozes (RFD) of 2N1P, **3** - RFD + soil application of the liquid fertilizer (SB5A) which equivalent to 2 liter of B5A/200 liter water/ha, **4** - RFD + 1B5A (foliar), which equivalent to 6 liters of B5A/200 liter water/ha as spited three times (2 liter each) at 2^{nd} , 4^{th} and 6^{th} irrigation, 5 - RFD + 2B5A (foliar), which equivalent to 12 liters of B5A/200 liter water/ha as spited three times (4 liters each) at 2^{nd} , 4^{th} and 6^{th} irrigation (foliar), **6 -** RFD + SB5A + 1B5A (foliar) and **7 -** RFD + SB5A + 2B5A (foliar). The treatments were arranged in RCBD with four replications. Application of B5A has significantly increased the seed yield at the three sites. The highest seed yield was obtained with the application of RFD + SB5A + 2B5A (foliar) which was 1744 kg/ha followed by the application of RFD +1B5A foliar (1741 kg/ha) at Gezira site. At both Rahad and New Halfa the highest seed yield obtained by addition of RFD + SB5A + 1B5A foliar (1750 kg/ha and 2877, respectively).

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KEYWORDS: B5A, foliar fertilizer, nitrogen fertilizer, phosphorous fertilizer Sunflower

INTRODUCTION

Most of the soils in Sudan are inherently low in nitrogen, phosphorus and organic matter. They contain on average less than 0.1 and 1% of these items, respectively, thus have poor chemical fertility. Phosphorous as a major element also is known to be unavailable to plants due to high clay contents, high $CaCO_3$, alkaline reaction (high pH) of those soils. As a result, the activities of soil microorganisms as well as plant growth and yield are reduced. The chemical fertilizers used to compensate for the poor fertility status of those soils. However, (Mafonogoya *et al.*, 1998) reported that, organic materials containing high N content have similar nitrogen availability patterns as mineral fertilizers with a large proportion of N available in advance of the main period of N-uptake by the growing plant.

Foliar fertilization of nutrients has become an established procedure to increase yield and to improve the quality of crop products (Romenheld, 1999). This procedure improves nutrient utilization and lower environmental pollution through reducing the amount of fertilizers added to soil. Foliar feeding of nutrients may actually promote root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrient uptake (Saqib *et al.*, 2006). Foliar fertilization method may also be a good substitute to the predictable soil application to avoid the loss of fertilizers by leaching and thereby minimizing the ground water pollution (Tomimori *et al.*, 1995). Foliar feeding of sunflower plants was found to be very much effective particularly in improving the physiological and yield traits (Kaleri *et al.*, 2019).

B5A Liquid is a foliar organic fertilizer with high concentration of organic matter, organic carbon, macro and micro nutrients which are shown on Table (1). It is provided to ARC by BMR Agriculture Husbandry and Fertilizers Exports, Imports, Industry and Trade, Turkey. The objective of this study was to evaluate the yield and quality responses of Sunflower to B5A liquid.

MATERIALS AND METHODS

Each experiment was consisted of 7 treatment, replicated four times and assigned in A randomized complete block design (RCBD) were adopted**:**

1. Control or check (Zero fertilizer).
2. Application of the recommended fertilizer dozes of nitrogen and phosphorous (RFD), which are 2N (=86 kg N/ha (as urea) and P (=43 kg P_2O_5 /ha as TSP).
3. (RFD)+soil application of the liquid fertilizer B5A (SB5A) which equivalent to 2 liter of B5A/200 liter water/ha.
4. (RFD)+1B5A (foliar), which equivalent to 6 liters of B5A/200 liter water/ha as 3 splits (2 liter each) at 2nd, 4th and 6th irrigation.
5. (RFD)+2B5A (foliar), which equivalent to 12 liters of B5A/200 liter water/ha as 3 splits (4 liters each) at 2nd , 4th and 6th irrigation.
6. (RFD)+(SB5A) + 1B5A (foliar) at 2nd , 4th and 6th irrigation.
7. (RFD)+(SB5A) + 2B5A (foliar) at 2nd , 4th and 6th irrigation.

Plot size = 4.8 x 10 m = 48 m^2. The dozes of SB5A and P were added at sowing. Sunflower crop was sown 16 December 2018 and the urea fertilizer doze was added at the sixth week after sowing. The dozes of B5A (foliar) were added as 3 splits at 2nd, 4th and 6th irrigation. Yield and yield components were calculated and statistically analyzed.

RESULTS AND DISCUSSION

Contents of nutrients in B5A

As shown on Table (1), B5A liquid is an organic fertilizer with a high concentration of organic matter, organic carbon, macronutrients and some micronutrients. The pH of the liquid is 9.4.

Effect of B5A liquid on plant growth parameters

1. **Plant height and head diameter**

Data in Table 2 show significant increase in plant height at Rahad gives by treatments 4 where the combination RFD + 1B5A foliar and Gezira gives by treatments 3 where the RFD + SB5A was added. The results at Halfa site showed no significant differences in plant height among different treatments. However, the increase in plant height might be attributed to increased efficiency in nutrient availability resulting in prolonged greenness and larger leaf surface as indicated by the result at all the growth stages. Similar results were reported by (Elnaz *et al.*, 2010) and (Tegegnework et al. 2015). Higher disc diameters were obtained at the three sites of the experiment with treatment (7) where the combination (RFD + (SB5A) + 2B5A foliar) was applied. However, the increase was significant only at Rahad and Gezira sites. Results are presented in Table 3 This increase in disc diameters may be due to considerably higher and balanced levels of fertilizer application. This result is in line with the work of Osman *et al.*, 1980 and Akram (1989).

2. **Seed yield and grain mass**

Grain mass as an important yield component was significantly affected by addition of B5A organic fertilizer. Results on Table (4) showed that the parameter weight of 1000 seeds gave significant increase with treatment (7) at both Gezira and Rahad sites. However, no significant differences among different treatments of the same parameter were found at Halfa site. Among fertilizer treatments, combined organic treatments and chemical treatments produced the maximum and minimum grain mass, respectively (Table 4). Increase in grain mass has been found to be related to the increase in nutrients uptake (Efeoğlu *et al.*, 2008). According to Hay and Porter (2006) consistent N availability increases dry matter production and leaf area duration. So it is not surprising that organic fertilizers play a major role in increasing grain mass.

The effect of application of B5A on sunflower on seed yield at the three sites is presented in Table (5). Application of B5A has significantly increased the seed yield at the three sites. Again the most profound positive response was obtained with treatment 7 (1744 kg/ha) followed by treatment 5 (1741 kg/ha) in Gezira. The highest seed yield was obtained with treatment 6 (1750 kg/ha) at Rahad. Treatment 6 also gave the highest seed yield (2877 kg/Ha) at New Halfa which was comparatively higher than those of the Gezira and Rahad. combined analysis was performed for all sites data as shown in Table (6).

The increase in yield may be due to greater accumulation of photosynthesis by vegetative parts in plants having microelement application such as Zn, since this element activates enzymes that are responsible for the synthesis of certain protein and that it helps in growth regulation and enhances stem elongation (Thiyageshwari, 2001). The efficiency of foliar fertilizers containing Zn nutrient was also reported by (Li *et al.,* 2019). These results verify that foliar application of micronutrients along with nitrogen plays an important role particularly in improving seed yield of field crops. (Praveen *et al.*, 2018). The better performance of sunflower with foliar spray of macro and micro nutrient may be due to the greater availability of nutrients and foliar fertilization is theoretically more immediate and target-oriented than soil fertilization since nutrients can be directly delivered to plant tissues during critical stages of plant growth. (Fernández and Brown, 2013). The present findings are in consonance with that of (Ramachandrappa and Najappa 2005) and that of Kassab (2005).

CONCLUSION

As could be seen from the results presented in Table (2) the application of B5A has enhanced sunflower yield dramatically. At all sites, the application of RFD + SB5A + 1B5A foliar gave yield superiority, where the percent increase of the combined means were 95% and 32 % over the control treatment and the recommended fertilizer dose (RFD), respectively, followed by the application of RFD + (SB5A) + 2B5A foliar where the percent increase of the combined means were 82% and 23 % over the control treatment and the recommended fertilizer dose (RFD), respectively.

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Table (1) Contents of B5A liquid organic fertilizer

B5A liquid organic fertilizer ingredient	level
Organic matter	26.2 %
Organic carbon	11.08 %
Total nitrogen	1.79 %
Phosphorous penta oxide	0.04 %
Water soluble potassium oxide	3.2 %
Cadmium	0.23 mg/kg
Copper	2.06 mg/kg

Nickel	2.81 mg/kg
Lead	0.32 mg/kg
Zinc	1048 mg/kg
Mercury	< 0.01 mg/kg
Chromium	0.19 mg/kg
pH	9.4

Table (2) Effect of B5A foliar fertilizer on plant height of sunflower

Treatment	**Plant height cm**		
	Gezira 2019	**Rahad 2019**	**Halfa 2019**
1. Control	124.0	142.0	135.0
2. RFD	124.0	155.0	145.0
3. RFD +SB5A	146.0	142.0	147.0
4. RFD +1B5A	142.0	156.0	146.0
5. RFD +2B5A	143.0	144.0	143.0
6. RFD +SB5A +1B5A	145.0	147. 0	150.0
7. RFD +SB5A +2B5A	141.0	144.0	153.0
F	***	*	NS.
C.V. %	2.36	5.11	6.14
SE±	1.2303	2.8669	3.3784

, **, *** = significant at P = 0.05, 0.01 and 0.001 level of probability ,respectively.
NS = not significant.

Table (3) Effect of B5A foliar fertilizer on disc diameter of sunflower

Treatment	**Disc diameter cm.**		
	Gezira 2019	**Rahad 2019**	**Halfa 2019**
1. Control	13.25	14.23	14.50
2. RFD	13.00	15.14	15.75
3. RFD +SB5A	15.50	13.52	15.75
4. RFD +1B5A	15.00	15.44	15.25
5. RFD +2B5A	14.75	14.32	15.00
6. RFD +SB5A +1B5A	15.25	14.48	15.75
7. RFD +SB5A +2B5A	15.75	17.71	16.00
F	***	*	NS
C.V. %	3.90	10.07	5.54
SE±	0.2156	0.5071	0.3230

, **, *** = significant at P = 0.05, 0.01 and 0.001 level of probability ,respectively.
NS = not significant.

Table (4) Effect of B5A foliar fertilizer on weight of 1000 seeds of sunflower

Treatment	**Wt. of 1000 seeds gm.**		
	Gezira 2019	**Rahad 2019**	**Halfa 2019**
1. Control	44.75	45.70	40.25
2. RFD	56.75	54.36	40.50

3. RFD +SB5A	47.50	48.78	39.75
4. RFD +1B5A	50.50	54.60	40.00
5. RFD +2B5A	53.25	50.94	39.00
6. RFD +SB5A +1B5A	55.25	52.75	44.00
7. RFD +SB5A +2B5A	61.00	55.02	41.75
F	*	*	NS
C.V. %	14.39	11.30	8.86
SE±	2.868	1.6854	1.3397

, **, *** = significant at P = 0.05, 0.01 and 0.001 level of probability ,respectively.
NS = not significant.

Table (5) Effect of B5A foliar fertilizer on seed yield of sunflower at the three sites

Treatment	Seed yield kg/ha		
	Gezira 2019	**Rahad 2019**	**Halfa 2019**
1. Control	571	903	1784
2. RFD	1349	1137	2314
3. RFD +SB5A	1340	1355	2095
4. RFD +1B5A	1316	1371	2072
5. RFD +2B5A	1741	1307	2185
6. RFD +SB5A +1B5A	1710	1750	2877
7. RFD +SB5A +2B5A	1744	1583	2588
F	***	***	***
SE±	156.7	104.8	136.7

, **, *** = significant at P = 0.05, 0.01 and 0.001 level of probability ,respectively.
NS = not significant.

Table (6) Combined effect of B5A foliar fertilizer on seed yield of sunflower at Gezira and Rahad sites

Treatment	**Seed yield kg/ha**			
	Gezira 2019	**Rahad 2019**	**Halfa 2019**	Combined 2019
1. Control	571	903	1784	1086
2. RFD	1349	1137	2314	1600
3. RFD +SB5A	1340	1355	2095	1597
4. RFD +1B5A	1316	1371	2072	1586
5. RFD +2B5A	1741	1307	2185	1744
6. RFD +SB5A +1B5A	1710	1750	2877	**2112**
7. RFD +SB5A +2B5A	1744	1583	2588	**1972**
F	***	***	***	***
Se±	156.7	104.8	136.7	124.4

, **, *** = significant at P = 0.05, 0.01 and 0.001 level of probability ,respectively.
NS = not significant.