Effects of NP and Biofertilizers on Growth and Some Yield Attributes of Sunflower *Helianthus Annus* L

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Abstract— *A field experiment was carried out in the demonstration farm of Sudan University of Science and Technology, College of Agricultural Studies, Shambat, for two consecutive seasons 2014/15 and 2015/16 to determine the effects of synthetic N (urea) and P (superphosphate) fertilizers and/or microbial biofertilizers on plant height (cm), number of leaves per plant, shoot and root dry weights, head diameter and 1000 seed weight of the sunflower hybrid Shambat. Nitrogen and phosphorus were applied at 100 and 50 kg/feddan, respectively. Biofertilizers were applied as a mixture of Azospirillum Brasilense (a nitrogen fixer) and Bacillus megaterium var. phosphaticum (a phosphate solubilizer). A combination of synthetic and biofertilizers was applied in addition to the control. NP treatment gave the highest values of growth parameters in the first season followed by biofertilizers. In the second season biofertilzers then their combination produced the highest values. Head diameter and 1000 seed weight were enhanced by NP fertilizers. Significant differences in the first season were found only between NP and the combination of NP + AB in the number of leaves per plant and root dry weight, and in the second season the same treatments were significantly different only in shoot dry weight.*

Keywords— Sunflower, biofertilizer, nitrogen, phosphorus, growth.

I. INTRODUCTION

Sunflower (*Helianthus annuus*), belonging to the family *Composite*, is an important oilseed crop containing high quality edible oil. It is easy to cultivate and grown in different conditions and soils (Kaya and Kolsarici, 2011and Lopez-Valdez *et al*., 2011). It is an emerging oil producing crop in Sudan after Groundnuts and sesame. The total area under sunflower in Sudan, season 2003/2004 was 6300 ha (Zubillaga et al., 2002).

Nitrogen and Phosphorus are the two most important major essential elements for growth and development of plants. They are applied in the form of chemical fertilizers. Such fertilizers pose health hazards and microbial population disturbances in soil besides their high cost. Excessive nitrogen fertilization of sunflower not only generates that environmental risk, it may also affect the grain quality, decreasing its oil content and reduce yield through an increase of plant lodging (Scheiner *et al*., 2002). In addition, soluble phosphorus under wide range of soil conditions converts to unavailable form because of phosphorus fixation. In such a situation the biofertilizers play a major role in organic agricultural practices that aim to enhance biodiversity, biological cycles and soil biological activity so as to achieve optimal natural systems that are socially, ecologically and economically sustainable (Samman *et al*. 2008).

Since the environmental and health problems arising from chemical fertilizers usage, attention has been drawn to the application of biological fertilizers in agriculture. Biological fertilizers or biofertilizers contain useful microorganisms, which could colonize the rhizosphere and promote plant growth through increasing the supply or availability of essential nutrients to the plants (Vessey, 2003). Soil microbes play an important role in many critical ecosystem processes, including nutrient cycling and homeostasis, decomposition of organic matter, as well as promoting plant health and growth as bio-fertilization (Han *et al*., 2007). Certain strains are referred to as plant growth-promoting rhizobacteria (PGPR), which can be used as inoculant biofertilizers. These bacteria include species of Azotobacter and Azospirillum, both of which provide direct and indirect effects on plant growth and pest resistance (Kennedy *et al*., 2004). Azotobacters and Azospirillum are free-living bacteria that fix atmospheric nitrogen in cereal crops without any symbiosis and they do not need a specific host plant

(Mahrous *et al*., 2014).It is well-recognized that microbial inoculants constitute an important component of integrated nutrient management that leads to sustainable agriculture. (Akbari *et al*., 2011).

In recent years, biofertilizers have emerged as a promising component of integrating nutrient supply system in agriculture. Our whole system of agriculture depends in many important ways, on microbial activities and there appears to be a tremendous potential for making use of microorganisms in increasing crop production. Microbiological fertilizers are an important part of environment friendly sustainable agricultural practices (Bloemberg et *al*., 2000).Nowadays multi-strain biofertilizers containing microorganisms, having a definite beneficial role in supporting plant growth and developing sustainable soil fertility (Mekki and Ahmed, 2005) are receiving much attention.

Regarding the significant role of N, and P in sustainable production of oil seed crops, an experiment was conducted to study the effect of biofertilizers on growth and some yield attributes of sunflower (*Helianthus annuus*. L).

II. MATERIALS AND METHODS:

A field experiment was conducted for two consecutive seasons in the years 2014/15 and 2015/16 at the Demonstration farm of the Faculty of Agriculture- Sudan University of Science and Technology, Khartoum-Sudan (Lat. 15° 40′ N, Long.32° 32′ E).Composite soil samples were collected from 0 to 30 cm depth and analyzed for some chemical soil properties determination (pH = 7.4, EC = 0.36dSm^{-1}).

The experiment was laid out in a randomized complete block design. Soil was ploughed, harrowed, leveled and cut into 70 cm apart ridges.

Seeds of Sunflower hybrid Shambat were sown in 16 m^{2}plots and 30 cm hole spacing with three seeds/ hole that are thinned to two after plant establishment. The first sample was taken 70days after sowing, and the second after 100 days. Parameters determined were plant height (cm), number of leaves, root and shoot dry weights (g), head diameter (cm)and 1000 seed weight (g). Treatments tested were as follows: nitrogen (urea) and phosphorus (superphosphate) synthetic fertilizers (NP) at rates of 100 and 50 Kg /Feddan of N and P, respectively. Biofertilizer mixture (AB) of *Azospirillum brazilense* (nitrogen fixer) and *Bacillus megaterium* var. phosphaticum (phosphate solubilizer) as carrier based biofertilizers, the combination of synthetic NP at half dose and bio-fertilizers (NP+AB)and a control set, all in triplicate.

Urea was added alongside ridges as split two doses, one at sowing and the other at flowering. Superphosphate was as a single dose at sowing. Biofetilizer mixture was added as a seed coating after seeds had been mixed with an adhesive (12% sucrose solution), then seeds were dried in shade for15 minutes, sown and irrigated immediately.

Data of the two seasons of the experiment were statistically analyzed separately according to the analysis of variance (ANOVA) using Statistic 8.0 computer software (2008).

III. RESULTS AND DISCUSSION

In table 1 nitrogen and phosphorus fertilizers (NP) treatment have generally improved growth parameters of sunflower plants especially in the first season, followed by the biofertilizer mixture (AB). However, Keshta*et al*. (2008) reported that plant height of sunflower was significantly less under biofertilization treatment than under the control treatment.

The greatest plant heights were obtained from the AB treatment with values of 149 cm and 160 cm for the first and second samples, respectively.

The highest number of leaves per plant (38.7) was obtained with NP treatment that was significantly superior to the combination NP + AB treatment in the first sample that could explained by the direct effect of nitrogen on shoot growth and vigor.

Regarding root dry weight, significant increase was obtained from both AB and the combination NP+AB treatments (65.7, 61.1gm) over NP in the second cut. Shoot dry weight was at its highest value (144gm) with the NP treatment in the first cut whereas in the second season the combination NP+ AB produced the highest value (270gm) which might be attributed to the enhancement of nutrient availability induced by the microbial growth promoting effect.

TABLE 1
EFFECTS OF N, P AND BIOFETILIZER ON GROWTH PARAMETERS OF SUNFLOWER SEASON2014/15

Treatment	Plant height (cm)		No. Leaves/plant		Root dwt (g)		Soot dwt (g)	
	1st sample	2nd sample	1st sample	2nd sample	1st sample	2nd sample	1st sample	2nd sample
NP	139.3 a	140.0 a	38.7 a	42.0 a	12.8 a	23.2 b	144.0 a	249.8 a
AB	149.0 a	160.3 a	32.7 ab	40.7 a	11.2 a	65.7 a	83.7 a	203.8 a
NP + AB	129.0 a	144.3 a	31.3 b	37.3 a	9.5 a	61.1 a	125.0 a	270.4 a
control	137.0 a	148.7 a	37.0 ab	40.0 a	7.7 a	34.1 ab	91.7 a	189.2 a
$SE_{0.05}$	11.10	10.09	2.90	2.42	3.80	14.49	28.20	57.33

Means denoted by the same letters within the column are not significantly different at (p=0.05) according to Duncan's multiple range test.

In the second season as shown (table 2) the results of the effects of different treatments on plant height, number of leaves, root and shoot dry weights were fluctuating with AB biofertilizer mixture giving the highest number of leaves in both the first (35) and second (35.3) samples taken and the highest root dry weight in the second sample (69.5g). The combination treatment gave the highest values in both plant height (150.7cm) and shoot dry weight (173.1g) with the latter giving significant increase over NP treatment. This is in good agreement with the findings of Mostafa and Abo-Bakr (2010) who stated that using biofertilizers of nitrogen fixing and phosphate dissolving bacteria in Egypt, significantly increased plant growth parameters compared with untreated plants. The biofertilizer application had stimulated nutrient accumulation and plant growth compared to the non treated plants (Amir *et al*., 2003). Moreover, the growth parameters of 30-day-old sunflower plants significantly increased shoot lengths with a maximum effect by each of phosphorein and potash biofertilizers in sunflower (Hala *et al*., 2012).

TABLE 2
EFFECTS OF N, P AND BIOFETILIZER ON GROWTH PARAMETERS OF SUNFLOWER SEASON2015/16

Treatment	Plant height (cm)		NO. Leaves/plant		Root dwt (g)		Soot dwt (g)	
	1st sample	2nd sample	1st sample	2nd sample	1st sample	2nd sample	1st sample	2nd sample
NP	144.0 a	192.3 a	33.0 a	33.7 a	10.2 a	43.0 a	86.6 b	171.3 a
AB	137.3 a	181.3 a	35.0 a	35.3 a	13.7 a	69.5 a	145.7 ab	262.4 a
NP + AB	150.7 a	189.0 a	33.0 a	32.0 a	9.0 a	46.8 a	173.1 a	221.9 a
control	137.3 a	180.7 a	34.0 a	35.0 a	15.4 a	60.3 a	144.9 ab	303.1 a
$SE_{0.05}$	17.08	14.48	3.08	1.48	6.25	18.81	34.96	67.27

Means denoted by the same letters within the column are not significantly different at (p=0.05) according to Duncan's multiple range test.

Regarding yield attributes of head diameter and 1000 seed weight sample, synthetic NP fertilizer treatment induced the largest increase but not at a significant level this result is in line with the findings of Mekki and Ahmed (2005) who found that soybean plants treated with biofertilizer singly, showed the lowest values of 1000 seeds weight in comparison to the other synthetic fertilizer treatments. The largest head diameter values were 13 cm in the first sample and 16 cm in the second. The greatest 1000 seed weight value was 66.6 g with NP followed by 59.8 cm obtained with the biofertilizer mixture AB, while the combination treatment ranked third (table 3). This could be explained by the fact that the synthetic NP fertilizers

supplied the plant need while half their dose in combination with the microbial biofertilizer was not sufficient to support plant needs and at the same time suppressive to the microbes.

These results showed that the differences between the treatments were not reaching the significant level. On the other hand, the treatment containing the sole mineral nitrogen was the superior one in the first season (table 3).

TABLE 3
EFFECTS OF N, P AND BIOFETILIZER ON HEAD DIAMETER AND 1000 SEED WEIGHT OF SUNFLOWER SEASON 2014/15

Treatment	Head diameter (cm)		1000 seed wt (g)
	1st sample	2nd sample	
NP	13.3 a	18.7 a	66.6 a
AB	10.7 a	14.7 a	59.8 a
NP + AB	12.0 a	16.0a	56.9 a
control	10.0 a	15.3 a	45.2 a
$SE_{0.05}$	1.70	2.50	11.02

Means denoted by the same letters within the column are not significantly different at (p=0.05) according to Duncan's multiple range test.

In the second season there were no heads and in the first sample and in the second all values were lower than the control. The same way, Keshta *et al*. (2008) reported that biofertilizer alone gave the lowest values of yield traits. However, the application of cerealine biofertilizer significantly increased head diameter of sunflower. Whereas, N at 45 kg /feddan was superior to bioertilizer in head diameter trait except for the 100 seed weight of sunflower (Keshta *et al*., 2008). According to our results the largest thousand seed weight was 83.4 g obtained by the NP treatment followed by 80.8 g at the AB microbial biofertilizer treatment (table 4).That could be due to that the release of N by the biofertilzer was not enough to compensate for then need by. These results are in agreement with those obtained by Abou-Khadrah et al. (2002).

TABLE 4
EFFECTS OF N, P AND BIOFETILIZER ON HEAD DIAMETER AND 1000 SEED WEIGHT OF SUNFLOWER SEASON 2015/16

Treatment	Head diameter (cm)		1000 seed wt (g)
	1st sample	2nd sample	
NP	-	18.3 a	83.4 a
AB	-	23.7 a	80.8 a
NP + AB	-	20.3 a	71.8 a
control	-	24.3 a	81.7 a
SE0.05	-	2.62	12.71

Means denoted by the same letters within the column are not significantly different at (p=0.05) according to Duncan's multiple range test.

IV. CONCLUSION

In this experiment where sunflower plants were treated with synthetic NP fertilizers and/ or NP biofertilizers, the growth parameters at the first season were enhanced by the synthetic NP fertilizers followed by the biofertilizers. In the second season biofertilizers caused the largest increase followed by the combination NP+AB. The head diameter and 1000 seed weight yield attributes were fairly increased by the synthetic fertilizers NP. Very few significant effects were recorded specially in yield attributes. We could conclude that biofertilizers could have a better impact on measured parameters and much work has to be carried out concerning dose adjustment of synthetic biofertilizers in particular when employing combination treatments.

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