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Evaluation of phosphorus fertilizer and azospirllum on number of head, number of branch and plant height on safflower

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Abstract

Safflower (*Carthamus tinctorius* L.) is an annual plant from the composite family, asteraceae and has vertical roots that can tolerate against environmental stresses such as salinity and water. Safflower cultivation is in the 1.3 million hectares with a production of 790 thousand tons. Phosphorus does not only increase seed yields but also nodulation and thus N fixation. Plant growth promoting rhizobacteria (PGPR) are a group of bacteria that actively colonize plant roots and increase plant growth and yield. The experiment was conducted at the lavaryab zahedan (in iran) which is situated between 29° North latitude and 60° East longitude and at an altitude of 1391m above Mean Sea Level. The field experiment was laid out in randomized complete block design with factorial design with three replications. Analysis of variance showed that the effect of azospirllum on number of head per plant, number of branch per plant and plant height was significant.

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Introduction

Safflower (*Carthamus tinctorius* L.) is an annual plant from the composite family, Asteraceae and has vertical roots that can tolerate against environmental stresses such as salinity and water (Lovelli *et al.* 2007, Bassil & Kaffka 2002, Bassiri *et al.* 1977). Thisis an oil plant that its oil has been considered as valuable oil due to having more than 90% unsaturated fatty acids, especially linoleic and oleic acids (Mundel *et al.* 1995). Safflower has potential to produce yield about 4 tons per hectare and the yield of 2 tons per hectare is considered as good yield (Omidi Tabrizi *et al.* 2000). The average of safflower yield is about 700 kg per hectare in Iran which is close to the average in the world (Foruzan 1999). Safflower cultivation is in the 1.3 million hectares with a production of 790 thousand tons. Most cropproducing countries are India, Mexico, America, China and Canada. Studies show that its origin is Middle East, especially Iran and Turkey (Barati & Arzani, 2012). Safflower, Carthamus tinctorius L., is a member of the family Composite or Asteraceae, cultivated mainly for its seed, which is used as edible oil and as birdseed. Traditionally, the crop was grown for its flowers, used for coloring and flavoring foods and making dyes, especially before cheaper aniline dyes became available, and in medicines. Safflower is a highly branched, herbaceous, thistle-like annual or winter annual, usually with many long sharp spines on the leaves. The plant has a strong taproot which enables it to thrive in dry climates. In India the crop has traditionally been grown in the winter dry season in mixtures with other crops, such as wheat and sorghum. After emergence, the crop maintains a rosette form for some weeks before rapid elongation to mature height. The florets are self-pollinating but seed set can be increased by bees or other insects. Safflower is one of humanity's oldest crops, but generally it has been grown on small plots for the grower's personal use (Gyulai 1996). not including a large number of small garden plots throughout India and Pakistan harvested for local use (Johnston *et al.*, 2002). Oil has been produced commercially and for export for about 50 years, first as an oil source for the paint industry, now for its edible oil for cooking, margarine and salad oil. Over 60 countries grow safflower, but over half is produced in India (mainly for the domestic vegetable oil market). Production in the USA, Mexico, Ethiopia, Argentina and Australia comprises most of the remainder. China has a significant area planted to safflower, but the florets are harvested for use in traditional medicines and the crop is not reported internationally. Safflower oil is used by farmers locally. However, safflower can be a potential oilseed crops for low-rainfall areas (Esendal, E., 2001). P deficiencies primarily result from either inherent low levels of soil P or depletion through cultivation. Phosphorus, although not required in large quantities, is critical to cowpea yield because of its multiple effects on plant nutrition (Muleba & Ezumal, 1985). Phosphorus does not only increase seed yields but also nodulation (Luse *et al.*, 1975; Kang & Nangju, 1983) and thus N fixation. Phosphorus application influences the contents of other nutrients in cowpea leaves (Kang & Nangju, 1983) and seed (Omueti & Oyenuga, 1970). Kudikeri *et al.* (1973) reported an increase of about 5% seed protein content of cowpea as a result of P application. Singh & Jain (1966) observed that P application increased the number of branches, dry weight of shoots and nodule number per cowpea plant, but other characters were unaffected. Phosphorus has also been reported to increase the number of leaves and fruits per plant, as well as earliness of flowering and yields (Kudikeri *et al.*, 1973). Application of P fertilizer is therefore recommended for cowpea production on deficient soils (Sellschop, 1962). Nitrogen fertilizers on the other hand, pose a health hazard and microbial population problem in soil besides the high cost of their application (Mahfouz and Sharaf-Eldin, 2007; Hasaneen *et al.*, 2009). Plant growth promoting rhizobacteria (PGPR) are a group of bacteria that actively colonize plant roots and increase plant growth and yield. The action mechanisms of PGPRs can be divided into direct and indirect ones. Direct mechanisms include N2 fixation, soil mineral solubilization, production of plant-growth-promoting substances (auxins, cytokinins or gibberellins) and reduction of ethylene levels, among others. Indirect mechanisms include favoring colonization by other beneficial soil microorganisms, such as mycorrhizal fungi, and repressing the growth of plant pathogenic microorganisms (Lugtenberg *et al.*, 2009; Marulanda *et al.*, 2010; Gholami *et al.*, 2009). The aims of the study were evaluation of phosphorus fertilizer and azospirllum on number of head, number of branch and plant height on safflower.

Materials and methods

Location of experiment

The experiment was conducted at the lavaryab zahedan (in iran) which is situated between 29° North latitude and 60° East longitude and at an altitude of 1391m above Mean Sea Level.

Annual rainfall

The average annual rainfall is 55 mm and the annual evaporation rate of 4500 to 5000.

Composite soil sampling

The soil of the experimental site belonging clay loam. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

Field experiment

The field experiment was laid out in randomized complete block design with factorial design with three replications.

Treatments

Treatments consisted of Azospirllum in 2 levels: no inoculation (A1), inoculation with azospirllum and azotobacter (A2) and phosphorus fertilizer in 4 levels: no phosphorus (P1), 100kg/ha (p2), 150kg/ha (p3), 200kg/ha (p4).

Data collect

Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

Results and discussion

Number of head per plant

Analysis of variance showed that the effect of azospirllum on number of head per plant was significant (Table 2). The maximum number of head per plant (26.35) of treatments inoculation of azospirllum was obtained (Table 3). The minimum number of head per plant (24.04) of treatments no inoculation was obtained (Table 3).

Table 1. Soil characteristics of the experiment during 2011 area growing season.

Year	Depth of soil (cm)	pH	Ec(ds /m)	N (%)	Ca(ppm)	K(ppm)	Sand	Silt	Clay
2012	0-30	7.98	6.5	0.036	11.4	97.36	74	4	22

Analysis of variance showed that the effect of phosphorus fertilizer on number of head per plant was significant (Table 2). The maximum number of head per plant (26.5) of treatments p4 was obtained (Table 3). The minimum number of head per plant (14.75) of treatments p1was obtained (Table 3). Analysis of variance showed that the Interaction of A*P was not significant (Table 2). The maximum number of head per plant (28.45) of treatments A2p3 was obtained (Table 3). The minimum number of head per plant (20.5) of treatments A1p1was obtained (Table 3).

Number of branch per plant

Analysis of variance showed that the effect of azospirllum on number of branch per plant was significant (Table 2). The maximum number of branch per plant (17.5) of treatments inoculation of azospirllum was obtained (Table 3). The minimum number of branch per plant (14.75) of treatments no inoculation was obtained (Table 3). Analysis of variance showed that the effect of phosphorus fertilizer on number of branch per plant was significant (Table 2). The maximum number of branch per plant (17.16) of treatments p4 was obtained (Table 3). The minimum number of branch per plant (12.5) of treatments p1was obtained (Table 3). Analysis of variance showed that the Interaction of A*P was significant (Table 2). The maximum number of branch per plant (19) of treatments A2p3 was obtained (Table 3). The minimum number of branch per plant (13.66) of treatments A1p1was obtained (Table 3).

Table 2. Analysis of variance for safflower affected by azospirllum and phosphorus fertilizer.

MS				
S.O.V	df	Number of head per plant	Number of branch per plant	Plant height
R	2	0.094ns	0.125ns	0.875ns
Azospirllum (A)	1	31.17**	45.37**	63.375**
phosphorus fertilizer (P)	3	32.25**	8.48**	182.153**
A*P	3	1.37ns	2.15**	25.375**
Error	14	1.19	0.64	1.065
C.V	-	7	4	14

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.

C.V: Coefficient of Variation.

Plant height

Analysis of variance showed that the effect of azospirllum on plant height was significant (Table 2). The maximum number of plant height (66.75) of treatments inoculation of azospirllum was obtained (Table 3). The minimum plant height (63.5) of treatments no inoculation was obtained (Table 3). Analysis of variance showed that the effect of phosphorus fertilizer on plant height was significant (Table 2). The maximum plant height (70) of treatments p2 was obtained (Table 3). The minimum plant height (52.33) of treatments p1was obtained (Table 3). Analysis of variance showed that the Interaction of A*P was significant (Table 2). The maximum plant height (71) of treatments A2p2 was obtained (Table 3). The minimum plant height (33.54) of treatments A1p1was obtained (Table 3).

Table 3. Means comparison of safflower affected by azospirllum and phosphorus fertilizer.

Treatment	Number of head per plant	Number of branch per plant	Plant height
A1	24.04b	14.75b	63.5b
A2	26.35a	17.5a	66.75a
P1	14.75b	12.5c	52.33b
P2	25.83a	16b	70a
P3	26.4a	16.83ab	65.5c
P4	26.5a	17.16a	67.66b
A1p1	20.5e	13.66d	33.54f
A1p2	25.33c	15cd	69c
A1p3	25c	14.66cd	62e
A1p4	25.33c	15.66bc	62.66e
A2p1	23d	15.33c	60.33e
A2p2	26.33bc	17b	71a
A2p3	28.45a	19a	69c
A2p4	27.66ab	18.66a	66.66d

Any two means not sharing a common letter differ significantly from each other at 5% probability

A1: no inoculation, A2: inoculation of azospirllum, P1: no phosphorus, P2: 100kg/ha phosphorus, P3: 150kg/ha phosphorus, A4: 200kg/ha phosphorus.

References

Barati M, Arzani A. 2012. Genetic diversity revealed by EST-SSR markers in cultivated and wild safflower. Biochemical Systematic and Ecology. **44**, 117–123.
http://dx.doi.org/10.1016/j.eja.2005.08.001

Bassil ES, Kaffka SR. 2002. Response of safflower (*Carthamus tinctorius* L.) to saline soils and irrigation. I. Consumptive water use. Agricultural Water Management **54,** 67-80.
http://dx.doi.org/10.1006/anbo.1999.1076

Bassiri A, Khosh-Khui M, Rouhani I. 1977. The influences of simulated moisture stress conditions and osmotic substrates on germination and growth of cultivated and wild safflowers. Journal of Agricultural Science **88,** 95- 100.
http://dx.doi.org/10.4141/cjps94-012

Esendal E. 2001. Safflower production and research in Turkey. Vth International Safflower Conference , Williston, North Dokota, Sidney, Montana, USA, July **27,** 203-206.
http://dx.doi.org/10.2478/v10247-012-0052-4

Gholami A, Shahsavain S, Nezarat S. 2009. The Effect of plant growth promoting rhizobacteria (PGPR) on geimination, seedling growth and yield of maize. World Academy of Science, Engineering and Technol. **49,** 19-24.
http://dx.doi.org/10.1016/S0308-521X(01)00023-3

Hasaneen M, Younis E, Toyrky SM. 2009. Plant growth, metabolism and adaptation in relation to strees conditions xxɪɪɪ. salinity-biofertility interactive effects on growth, carbohydrates and photosynthetic efficiency of Lactuca sativa. Plant Omics J. **2,** 60-69.
http://dx.doi.org/10.1093/aob/77.6.591

Kudikeri CB, Patil RV, Karishnamurthy K. 1973. Response of Cowpea Varieties under varying levels of Phosphorus. Mysore J. Agric **7(2),** 170 -177.
http://dx.doi.org/10.2135/cropsci1992.0011183X003200030033x

Lovelli S, Perniola M, Ferrara A, Di Tommaso, A. 2007. Yield response factor to water (ky) and water use efficiency of Carthamus tinctorius L. and Solanum melongena L. Agricultural Water Management **92,** 73-80.
http://dx.doi.org/10.1071/P9930639

Lugtenberg B, Kamilova F. 2009. Plant-growth promoting rhizobacteria. Annu. Rev. Microbiol. **63,** 541–556.
http://dx.doi.org/10.1017/S0960258500004141

Mahfouz SA, Sharaf-Eldin MA. 2007. Effect of mineral vs. bio-fertilizer on growth, yield and essential oil content of fennel (*Foeniculum vulgare*). Int. Agrophysics, **21,** 361-366.
http://dx.doi.org/10.1016/j.eja.2005.10.006

Marulanda A, Azcon R, Chaumont F, Ruiz-Lozano JM, Aroca R. 2010. Regulation of plasma membrane aquaporins by inoculation with a Bacillus megaterium strain in maize (*Zea mays* L.) plants under unstressed and salt-stressed conditions. Planta **232,** 533–543.
http://dx.doi.org/10.1017/S0960258500003032

Mundel H, Hung H, Kozub G, Barr D. 1995. Effect of soil moisture and temperature on seedling emergence and incidence of Pytium damping-off in safflower. Canadian Journal of Plant Science **75,** 505-509.
http://dx.doi.org/10.1017/S0960258500004141

Mundel H, Hung H, Kozub G, Barr D. 1995. Effect of soil moisture and temperature on seedling emergence and incidence of Pytium damping-off in safflower. Canadian Journal of Plant Science **75,** 505-509.
http://dx.doi.org/10.1016/j.indcrop.2006.07.004

Omueti JO, Oyenuga VA. 1970. Effect of Phosphorus Fertilizer on the Protein and essential components of the ash of groundnut and Cowpeas. West African Biology and Applied Chemistry Journal **13**, 299 – 305.

Sellschop JPF. 1962. Cowpeas. (*Vigna unguiculata* [L] Wallp). Field Crops Abstracts **15,** 259 – 266. http://dx.doi.org/10.1016/S0308-521X(01)00023-3

Singh RM, Jain TC. 1966. Effect of Phosphate and Molybdate on the Growth Caracters of Russian Giant Cowpea in: Cowpea: Abstract of World Literature **12,** 110- 131. http://dx.doi.org/10.2135/cropsci1997.0011183X003700010038x