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Effect of Nitrogen Fertilizers on the Yield of Host Plant, Sunflower (*Helianthus annuus*) in Presence of Parasitic Plant (*Orobanche aegyptiaca*)

[1]Narges Mesbah and [2]Syyed Ali Noorhosseini
[1]Department of Agronomy, Naragh Branch, Islamic Azad University, Naragh, Iran
[2]Department of Agronomy, Gorgan Branch, Islamic Azad University, Gorgan, Iran

Abstract: In order to evaluate the effects of type and amount of nitrogen fertilizers on control of broomrape in prescience of sunflower, as host plant a factorial experiment in randomized complete block design were down in Saveh Islamic Azad University with 4 replication. First factor was type of fertilizer (urea, amonium nitrate, amonium phosphate). Second factor was concentration nitrogen (0, 2, 4 and 5 ppm). Results of this experiment showed that effect of type of nitrogen fertilizer on dry seed weight, dry weight of broomrape and number of broomrape is significant ($p<0.01$). Highest dry weight of stem and leaf of sunflower were in concentration of 4 ppm of amounium nitrate. In concentration of 5 ppm of ammonium nitrate, ammonium phosphate and urea fertilizers, highest seed of sunflower weighted. Lowest dry weight of broomrape was in concentration of 2 and 4 ppm of ammonium nitrate and least number of broomrape were counted in 5 ppm of urea form of fertilizers.

Key words: Broomrape, nitrogen fertilizers, sunflower, block design, Iran

INTRODUCTION

Sunflower is a plant from Asteraceae family indigenous to central parts of continent America. It originated from Peru and Mexico. Cultivation of sunflower, as a nut was a common praxtice in various parts of Western Azerbaijan about 80 years ago, for example in Khoy City. However as an oil seed, its cultivation has been popular since 1344 (Mahmoodifar *et al*., 2010). One of most important problems is sunflower cultivation in different parts of the country is the weeds resulting to qualitative and quantitative deterioration of sunflower product. One of most important weeds common in sunflower fields is parasitic plant broomrape orobanche aegyptiaca.

This plant belongs to the family orobanchaceae. This family has 17 genus and >150 species contaminating an area about 16 millions ha of agricultural lands across the world. Species *O. cernua* and *O. aegyptiaca* are among most important species of this plant in Iran (Banihashemi and Ahmadi, 1986).

According to Nandula (1998), the major contamination region of this plant is mediterranean area. Regions with climates similar to this area, such as California, Western Australia and Cuba also are invased by this plant. Any way, this plant is wide spread in 14 countries mainy locating in Asia including Afghanistan, Pakistan, Iran, Turkey, Lebanon, Israel, Saudi Arabia, Egypt, Cuba, Nepal, Syria, Greek, Iraq, Italy and Spain. It is among most problematic parasitic flowering plants in these countries. Species *O. aegyptiaca* is among most important species of this plant in Iran (Behdad, 1979) various chemical, mechanical, biolocal and agricultural control techniques have been studied to control this plant. Among them, agricultural control is among the popularizing techniques to control broomrape. Chemical fertilizers treatment is considered as agricultural control techniques (Behdad, 1990). Various tests indicated that nitrogen fertilizers might lead to decrease the growth of this parasitic plant and increase the competitive power of host plant (Mahmoodifar *et al*., 2010). According to Van Hezewijk *et al*. (1993), application of nitrogen in the amount equal to 4 mmol urea or ammonium decreases the germination of *O. cernua*.

Parker and Riches (1993) recommend applying nitrogen fertilizer to decrease the severity of damage by *O. cernua* striga astitica on host plant. Parker and Riches (1993) indicated that germination and growth of *O. crenata* was more influenced in presence of 4 μmol N in the form of urea compared to its ammonium formula. Nevertheless, nitrate did not affect on it. Dhanapal *et al*. (1996) indicated that germination and growth of *O. crenata* was greatly influenced by 4 μmol N in the form of urea or ammonium during preparation and germination.

MATERIALS AND METHODS

This test were performed in the green house of Agriculture Collage, Islamic Azad University, Saveh

Corresponding Author: Narges Mesbah, Department of Agronomy, Islamic Azad University, Naragh Branch, Naragh, Iran

Branch, as factorial test in randomized complete block design with 4 replications. Seeds of broomrape species orobanchia degyptiaca were collecte from farms contaminated to this plant in Tonkaman region in 2010. First factor was the type of nitrogen fertilizer in 3 levels including: Urea fertilizer (containing 46% pure nitrogen), ammonium phosphate (containing 36% pure nitrogen) and ammonium nitrate (containing 33% pure nitrogen). Second factor was amount of nitrogen fertilizer in 4 levels including 0 (control treatment), 2, 4 and 5 ppm pure nitrogen fertilizer concentrations.

The 10 kg pots was filled with soil consisting 30% clay, 15% loam, 45% sand and 10% completely decade and striled manure (for 25 h in 105°C). Within each pot, 2 mg seed of this plant was added and seeds were completely mixed with pot soil. During preparation period (pre conditioning), pots were maintained in greenhouse for 3 weeks in 20°C, irrigation was performed twice per week. Sunflower seed of Shfagh cultivar was supplied from Institute for Research, Breeding and Production of Sapling and Seed, Karaj City. At the end of seed preparation period, 3 seeds were planted in each pot. About 2 weeks after plantation of seeds was performed thinning operation and one plant was kept in each pot. In the plots in which ammonium phosphate was not utilized, as controlling treatment for broomrape, phosphorus oxide was used to maintain the equilibrium of phosphorous element, so that phosphor being in equal amount in all pots.

Pots were irrigated in adequate, specified time intervals and were kept in 22-25°C with intensity of 10,000 lux. Simultaneous to initiation of leaf yellowing and decreasing the crops growth and development was performed harvestation. In the final harvestation, meseared data was including stem Dry Weight (DW), leaf DW, sunflower DW seed and root DW. Broomrape DW and the number of broomrape bushes. Samples weighting was performed use a balace with 1% of gram. Required statistical calculation was performed use SAS software. Data display was performed by using Excel.

RESULTS AND DISCUSSION

Stem dry weight in sunflower: Results of analysis of variance indicated that effect of the type of nitrogen fertilizer, as well as interaction of fertilizer type x fertilizer concentration in 1% level is not significant on sunflower stem dry weight. Nevertheless, influenced of nitrogen fertilizer concentration on sunflower stem dry weight was significant in 1% (Table 1).

Comparing the data means indicated that effect of nitrogen fertilizer type on sunflower stem weight was significant in 1% (Table 2). Maximum stem dry weight was observed in ammonium nitrate fertilizer treatment (39.95 g) and lowest sunflower stem dry weight was observe in ammonium phosphate treatment (33.08 g).

Comparing the data means indicated the nitrogen fertilizer concentration's effect was significant on sunflower stem dry weight in 1% (Table 3). With increase in nitrogen fertilizer concentration, sunflower stem dry weight was increased and greatest sunflower stem dry weight was achieved in 5 ppm concentration (36.51 g).

Comparison of data means indicated that interatcion of type of nitrogen fertilizer x nitrogen fertilizer concentration affects significantly on sunflower stem dry weight in 1% (Table 4). Greatest sunflower stem dry weight was achieved in 5 ppm concentration of urea and ammonium nitrate (31.99 and 32.50 g, respectively) and both were placed in one statistic group. Results of study by Hybrid (Westwood and Foy, 1999) indicated that effect of nitrogen fertilizer type and concentration of tobacco stem dry weight was significant in 1%. Greatest tobacco stem dry weight was achieved by using 200 kg ammonium nitrate per hector.

Leaf dry weight in sunflower: Results of data variance analysis indicated that effect of the type of nitrogen fertilizer and interaction of fertilizer type x nitrogen fertilizer concentration on sunflower leaf dry weight was not significant. However, amount on nitrogen fertilizer had significant effect on sunflower leaf dry weight in 1% level (Table 1).

Comparison of data means indicated significant effect of nitrogen fertilizer on sunflower leaf dry weight (Table 2). Greatest and lowest sunflower leaf dry weight were achieved in ammonium nitrate fertilizer (5.59 g) and ammonium phosphate (4.54 g) treatments.

Comparing the mean data indicated the significant effect of nitrogen fertilizer concentration on sunflower leaf dry weight in 1% (Table 3). Greatest sunflower leaf dry

Table 1: Variance analysis of effect of nitrogen fertilizer type and amount on sunflower contamination to broomrape

		Mean square					
S.O.V	df	No. of broomrape	Dry weight of broomrape	Root dry weight in sunflower	Seed dry weight in sunflower	Leaf dry weight in sunflower	Stem dry weight in sunflower
Replication	2	2.0432^{NS}	4.080^{NS}	0.017^{NS}	10.590^{NS}	0.380^{NS}	0.254^{NS}
N fertilizer type	2	3.0127**	25.249**	1.164^{NS}	345.080**	6.740^{NS}	1.516^{NS}
N fertilizer concentration	3	23.1890**	0.828^{NS}	44.913**	1131.050**	74.330**	25.520**
Interaction	6	1.8970^{NS}	0.237^{NS}	1.056^{NS}	62.720**	3.814^{NS}	1.211^{NS}
CV (%)		21.8900	12.261	18.270	14.726	18.173	26.595

Table 2: Comparison of mean effect of fertilizer type on the properties of sunflower and broomrape

N fertilizer type	No. of broomrape	Dry weight of broomrape	Root dry weight in sunflower	Seed dry weight in sunflower	Leaf dry weight in sunflower	Stem dry weight in sunflower
Ammonium nitrate	7.54[a]	5.24[b]	5.12[a]	25.22[a]	5.59[a]	39.95[a]
Urea	7.67[a]	8.87[a]	4.99[b]	31.22[a]	5.76[a]	31.80[b]
Ammonium phosphate	6.43[b]	5.49[b]	4.52[b]	20.53[b]	4.54[b]	33.08[c]

Table 3: Effect of nitrogen fertilizer concentration on the measured properties in sunflower and broomrape

N fertilizer concentration (ppm)	No. of broomrape	Dry weight of broomrape	Root dry weight in sunflower	Seed dry weight in sunflower	Leaf dry weight in sunflower	Stem dry weight in sunflower
0	6.71[a]	6.35[a]	2.48[d]	12.13[c]	3.81[d]	3.16[b]
2	6.34[a]	6.42[a]	3.87[c]	20.74[b]	9.41[c]	30.07[b]
4	5.45[b]	6.27[a]	5.47[b]	32.76[a]	14.15[b]	31.74[b]
5	4.71[b]	5.75[b]	7.68[a]	36.81[a]	18.20[a]	36.51[a]

Table 4: Comparison of mean effect of interaction of nitrogen fertilizer type and amount and sunflower and broomrape properties

N fertilizer type	N fertilizer concentration (ppm)	No. of broomrape	Dry weight of broomrape	Root dry weight in sunflower	Seed dry weight in sunflower	Leaf dry weight in sunflower	Stem dry weight in sunflower
Ammonium nitrate	0	7.26[b]	6.53[a]	13.79[f]	5.27[e]	6.17[e]	12.84[d]
Ammonium nitrate	2	6.56[d]	6.32[a]	17.84[e]	11.10[b]	12.13[c]	24.60[b]
Ammonium nitrate	4	5.70[d]	6.11[a]	24.46[a]	13.24[a]	19.43[b]	28.78[b]
Ammonium nitrate	5	5.16[d]	5.14[c]	26.12[a]	14.63[a]	21.75[a]	31.99[a]
Ammonium phosphate	0	8.12[a]	5.80[b]	16.30[c]	7.37[e]	8.32[e]	14.66[d]
Ammonium phosphate	2	7.54[b]	4.49[b]	18.33[d]	9.62[e]	10.55[d]	15.55[d]
Ammonium phosphate	4	6.12[c]	4.27[c]	20.76[c]	12.44[b]	12.87[c]	19.11[c]
Ammonium phosphate	5	5.23[d]	5.17[c]	20.93[c]	15.14[a]	14.90[c]	21.72[b]
Urea	0	6.45[c]	5.63[b]	16.26[c]	7.11[e]	6.81[e]	12.44[d]
Urea	2	5.56[e]	5.55[b]	18.46[d]	11.53[b]	11.15[e]	23.91[b]
Urea	4	5.09[e]	5.30[c]	23.24[b]	13.82[a]	19.81[b]	30.01[a]
Urea	5	4.20[f]	5.05[d]	22.96[b]	14.67[a]	22.04[a]	32.50[a]

weight was achieved in 5 ppm concentration (18.20 g) and lowest sunflower leaf dry weight was observed in 0 ppm concentration (3.81 g).

Effect of interaction of fertilizer type x nitrogen fertilizer concentration on sunflower leaf dry weight was significant in 1%. Greatest sunflower leaf dry weight was achieved in 5 ppm concentration of urea and ammonium intrate fertelizers (22.04 and 21.75 g, respectively) and both were placed in same statistical group.

Results of study by Jamnejhad and Moaveni (2010) indicated that the type of nitrogen fertilizer, as well as interaction of nitrogen fertilizer x manure concentration significantly affect on wet and dry weight of tomato leaf in 1% level. Greatest dry weight of tomato leaf was achieved by applying urea in 150 kg and administrating 30 ton manure.

Seed dry weight in sunflower: Results of variance analysis indicated that effect of the type of nitrogen fertilizer, concentration of nitrogen fertilizer and interaction of fertilizer type x nitrogen fertilizer concentration on seed dry weight is significant in 1% (Table 1).

Comparing data mean indicated that the type of nitrogen fertilizer significantly affects on sunflower seed dry weight in 1% level (Table 2). Greatest seed dry weight was placed in urea fertilizer (31.22 g) and ammonium phosphate treatment had lowest seed dry weight (20.53 g).

Comparing the data means indicated that effect of nitrogen fertilizer concentration on the seed dry weight was significant in 1% level (Table 3). By increasing the nitrogen fertilizer consumption, seed dry weight increased. Greatedst seed dry weight was placed in 4 and 5 ppm nitrogen fertilizer (36.81 and 36.76 g, respectively) which jointly were placed in the 1st group. Results of comparing the data means indicated that interaction of nitrogen fertilizer type x nitrogen fertilizer concentration significantly affects on seed dry weight in 1% level (Table 4). Greatest seed dry weight was achieved in 5 ppm by urea and ammonium nitrate (14.67 and 14.63, respectively).

Esilaba *et al.* (1999) in the study on the effect of soil fertilization and management on parasitic plant of grass broom resported that influence of the type of nitrogen fertilizer and its amount on host plant's yield is significant in 1% level. According to the results of this study, urea and ammonium nitrate fertilizer increase the host plant's seed yield.

According to Etagegnehu and Suwanketnikom (2004), nitrogen fertilizer by decreasing the number of empty seed in each story will increase sunflower seed performance. Given the effect of nitrogen fertilizer on wet weight of broomrape and the number of this plant obtained in this study, it can been concluded that nitrogen fertilizer consumption will decrease the growth of this plant and this in turn increased sunflower seed yield.

Root dry weight in sunflower: Results of variance analysis indicated that effect of nitrogen fertilizer, as well as interaction of nitrogen fertilizer type x concentration was not significant in 1% level. However, effect of nitrogen fertilizer was significant on root dry weight in 1% (Table 1).

Comparing data means indicated that effect of nitrogen fertilizer type on root dry weight was significant in 1% and greatest root dry weight was significant in 1% and greatest root dry weight was observed in 5.12 g ammonium nitrate treatment (Table 2). Comparing data means indicated that effect of nitrogen fertilizer concentration on root dry weight was significant in 1% (Table 3). Greatest root dry weight was achieved by 5 ppm concentration (7.68 g). Results of data mean comparison indicated that effect of interaction of fertilizer type x nitrogen fertilizer concentration was significant on root dry weight. Greatest root dry weight was achieved in 5 ppm concentration by urea (22.96 g).

Results of study by Etagegnehu and Suwanketnikom (2004) indicated that the type and amount of nitrogen fertilizer on root dry weight was significant in 1%. Greatest root dry weight was achieved in urea fertilizer treatment with 200 kg h^{-1}.

Dry weight of broomrape: Results of data variance analysis indicated that effect of nitrogen fertilizer type on dry weight of broomrape is significant. But nitrogen fertilizer concentration, as well as interaction of fertilizer type x nitrogen fertilizer concentration was not significant in 1% (Table 1).

Comparing the data means indicated that effect of nitrogen fertilizer type on broomrape dry weight is significant in 1% level (Table 2). Greatest dry weight was achieved in urea fertilizer treatment (8.87 g) and 2 treatments of ammonium phosphate and ammonium nitrate were placed in 2nd group (5.49 and 524 g, respectively).

Results of data comparison indicated that effect of nitrogen fertilizer concentration on broomrape dry weight was significant in 1% level (Table 3). Dry weight of broomrape in 3 concentrations of 0, 2, 4 ppm was placed in 1st group (6.35, 6.42 and 6.27, respectively) and dry weight of this plant in 5 ppm concentration was placed in 2nd group (5.75 g).

Results of data mean comparison indicated that effect of interaction of fertilizer type x nitrogen fertilizer concentration on dry weight of this plant is significant in 1% level (Table 4). Greatest dry weight of broomrape was achieved in concentrations 2 and 4 ppm ammonium nitrate (6.32 and 6.11 g) and lowest dry weight was achieved in 4 ppm ammonium phosphate (4.27 g).

Results of Jain and Foy (1992) indicated that effect of nitrogen fertilizer amount and type on wet and dry weight of broomrape is significant. So that by increase in N concentration, wet and dry weight of broomrape will decrease. According to this researcher, ammonium nitrate by decreasing the length of sprout tube of parasite plant of broomrape decrease the connection and growth of this plant and eventually decreases the dry weight of the plant. According to Richs, *S. asiatica* is more wide spread in the soils with N shortage and invasion to its hosts is more common. Parker and Riches (1993) indicated that germination and growth of *O. cerenata* in the oresence of 4 μmol nitrogen fertilizer in urea form will be more influenced than its ammonium form but nitrate does not have effect on it.

The number of broomrape *(O. aegyptiaca)*: Results of data variance analysis indicated that effect of nitrogen fertilizer type, as well as nitrogen concentration on the number of broomrape is significant in 1% level. But, it did not have significant effect on interaction of fertilizer type x nitrogen concentration (Table 1). Comparing the data means indicated that effect of nitrogen fertilizer type on the number of broomrape is significant in 1% level (Table 2) and greatest number of this plant was achieved in urea treatment (7.67) and lowest number was achieved in ammonium nitrate treatment (6.43).

Results of data means comparison indicated that the effect of N concentration on the number of *O. aegyptiaca* is significant in 1% level (Table 3). The number of *O. aegyptiaca* was lowest in 5 ppm concentration of nitrogen fertilizer (4.71) and highest number of this plant was achieved in 0 and 2 ppm nitrogen fertilizer both of them placed in the same statistic group (6.71 and 6.34, respectively). Data mean comparison indicated that effect of interaction of fertilizer type x nitrogen concentration was significant of *O. aegyptiaca* in 1% level (Table 4). Lowest number of this plant was achieved in 5 pp, concentration urea (4.27) and greatest number of this plant was achieved by 0 ppm concentration of from 3 types of nitrogen fertilizer; ammonium nitrate, ammonium phosphate and urea (7.56, 8.12 and 8.45, respectively). Results of Thalouarn *et al.* (1990) indicated that however parasitic plants germinate with lower speed in presence of N resources but greater growth and development of host plants may indirectly influence of parasite plants growths.

Results of Abu-Irmaileh (1994) indicated that contamination of the field by *O. aegyptiaca* has close relationship to N compositions available in the soil. These results indicate that urea decreases the contamination rate of the field to *O. aegyptiaca*. Influence of nitrogouse and ammonium fertilizers on decrease of contamination to this plant was following the effect of urea fertilizer.

CONCLUSION

While nitrogen effect on the germination was no significant in this plant. It seems that various nitrogen fertilizers by affecting on soil pH have different effects on the capacity of germination and growth of this plant. Present study aims to study, the effect of type and amount of nitrogen fertilizers on the componments of sunflower yield in the presence of broomrape.

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