

Effects of Nitrogen Fertilizers on Growth of Egyptian Broom Rape (*Orobanche aegyptiaca*) in the Presence of the Host of Sunflower (*Helianthus annuus*) in Pot Conditions

¹Narges Mesbah, ²Hamid Dehghanzadeh and ³Manochehr Jamnejad

¹Department of Agronomy, Nragh Branch, Islamic Azad University, Nragh, Iran

²Department of Agriculture, Payame Noor University, Tehran, Iran

³Department of Agronomy, Saveh Branch, Islamic Azad University, Saveh, Iran

Abstract: In order to evaluation of the effects of type and amount of nitrogenous fertilizers on germination and growth of Egyptian broom rape (*Orobanchia aegyptiaca*) and their ability in reduction of yield of sunflower, this experiment was conducted in the form of factorial experiment in a completely randomized block designs with 4 replications, in experimental greenhouse of Islamic Azad University of Saveh. With increasing of nitrogen fertilizers concentration, studied indices (bush height of sunflower, fresh weight of stem, leaf and crop of sunflower) were increased. In the other side, with increasing of nitrogenous fertilizer, the amount of broom rape germination was decreased. In interaction of type of nitrogenous fertilizers and amount of nitrogenous fertilizer, the maximum yield of sunflower seed in the concentration of 5 ppm of urea fertilizer was obtained. The minimum amount of broom rape germination also was obtained from the concentration of 5 ppm of urea fertilizer.

Key words: Broom rape, nitrogenous fertilizer, sunflower, growth, urea, fertilizer, Iran

INTRODUCTION

Broom rape (*Orobanche* sp.) is a parasitic plant from Orbanchaceae family which has been scattered in >80 countries and an area of about 16 milion ha of agricultural lands is infected by broom rape in the world. Infection severity of this parasitic plant in Iran is such that in some cases farmers leave cultivated land (Jamnejad and Baghestani, 2003). Since >10 variety of this parasitic flowering plant has been identified in Iran and its damage in the farm and some of gardens have been proved which the most important and common of them is Egyptian broom rape (*Orobanche aegyptiaca*) (Mousavi and Shimi, 1997). Generally, broom rape parasitizes cereal, Solanaceae, Brassicaceae, Asteradceae, Apiaceae and Cucurbitaceae and other magnoliopsida but these parasitic plants have not been observed on monocotyledons up to now (Mousavi and Shimi, 1997). However, broom rape has been scattered in 14 countries which are in Asia such as Afghanistan, Pakistan, Iran, Turkey, Lebanon, Israeli, Egypt, Saudis Arabia, Cuba, Nepal, Syria, Iraq, Italy and Spain (Westwood and Foy, 1999).

Different methods of chemical, mechanical, biologic and crop control of broom rape has been reviewed. Crop control is one of the most popular methods in broom rape control and is one of the methods of crop control of

chemical fertilizer treatments (Abu-Irmaileh, 1981). Several experiments have shown that nitrogenous fertilizers can decrease the growth of parasitic plant of broom rape and can increase competitive ability of host plant (Jamnejad and Baghestani, 2003). This research was done in order to study of the effect of type and amount of nitrogenous fertilizers on the components of sunflower performance in the presence of broom rape.

The results of Jain and Foy (1992) experiment showed that parasitic performance of broom rape is decreased by using sodium nitrate, potassium nitrate, sodium phosphate and a combination of ammonium nitrate and potassium phosphate. In order to Van Hezewijk *et al.* (1993), usage of nitrogen by 4 M mole in the form of urea or ammonium causes reduction of germination (Nandula, 1998). Foy *et al.* (1991) recommended usage of nitrogenous fertilizer in order to reduction of damage severity of broom rape (*O. cernua*) and witch weed (*Striga asiatica*) on host plant. Westwood and Foy (1999) showed that ammonium nitrate and ammonium phosphate cause reduction of biomass production (*O. ramosa*) in the presence of hosts of tobacco and tomato in the pot conditions.

Abu-Irmaileh (1994)'s researches showed that usage of nitrogenous fertilizer in high quantities causes reduction of broom rape development (*O. cernua*) in tobacco and tomato farms and also in the study of

nitrogenous fertilizers effects on broom rape growth, they concluded that generally, ammonia fertilizers have more deterrent effect on the broom rape rather than nitrate nitrogen. Also, the results of Abu-Irmaileh (1981)'s researches showed that usage of ammonium nitrate fertilizer by 10 g per each pot causes the reduction of broom rape Infection in tobacco.

Bedawi *et al.* (1984), in the study of longevity of witch weed seed (*Striga asiatica*) observed that nitrogen causes reduction of longevity of witch weed seed. In this research, ammonium fertilizers decrease the longevity of witch weed more than nitrate fertilizers. Marium and colleagues' researches on the effect of different levels of nitrate fertilizers reduction of damage and the number of broom rape in the presence of tomato showed that usage of 207 kg ha⁻¹ of pure nitrogen of chemical fertilizers such as ammonium sulfate and ammonium nitrate and urea causes the reduction of broom rape and also the increasing of tomato but adding 276 kg pure nitrogen of mentioned fertilizers causes poisoning and damage in tomato and also in other experiment, adding 3 types of manure and every type of organic fertilizer in 2 levels of 20 and 30 tons ha⁻¹ causes the reduction of broom rape infection to tomato bushes. In this experiment, with increasing of manure from 20-30 ton ha⁻¹, not only burning marks were not seen in tomato bushes but also causes the increasing of performance and also the reduction of broom rape invasion (Marium and Suwanketnikom, 2004).

MATERIALS AND METHODS

This experiment was done in the greenhouse of agriculture faculty in Islamic Azad University of Saveh. The seed of used broom rape (*Orobanchia aegyptiaca*) in Winter of 2007 was provided from the greenhouse of agricultural research center of Arak. This test was conducted in the form of factorial experiment in a completely randomized block designs with 4 replications. First factor was the type of chemical fertilizer consisting of nitrogen in 3 levels of a₁ (Urea fertilizer consisting of 46% of pure nitrogen), a₂ (Ammonium phosphate consisting of 36% of pure nitrogen) and a₃ (Ammonium nitrate consisting of 33% of pure nitrogen). Second factor was the amount of nitrogen fertilizer in 4 levels of b₁ (No-usage of nitrogen fertilizer (control treatment)), b₂ (Usage of nitrogen fertilizer by the concentration of 2 ppm), b₃ (Usage of nitrogen fertilizer by the concentration of 4 ppm) and b₄ (Usage of nitrogen fertilizer by the concentration of 5 ppm). The soil of pots consisting of 30% of clay, 15% of loam, 45% of sand and

10% of manure was completely decayed which was put on the oven at the temperature of 105° for 24 h in order to disinfection. Within each pot, 10 kg of disinfected soil was added.

Within each pot, 2 mg of broom rape seed was added and seeds were mixed with soil completely. In order to pre-conditioning, pots were maintained in greenhouse at temperature of 20° for 3 weeks and were irrigated per fortnight. Used sunflower seed in this experiment was Shafagh cultivar and was provided from agricultural research center. Cultivation of sunflower seeds was done with the end of pre-conditioning simultaneously. About 3 seeds were cultivated in each pot. About 2 weeks after seed cultivation, sparse operation was done and 1 bush was maintained in each pot. In pots in which ammonium phosphate was not used as control treatment of broom rape, phosphor oxide was used in order to maintenance of balance of phosphor so that phosphor amount becomes same in all pots. Pots were irrigated in appropriate and certain time intervals and then in the time of sparse, it was decreased to 1 bush. Pots were maintained in the greenhouse of agriculture faculty of Saveh. The temperature of growth environment was 22-25°C and the severity and quality of chamber's light were examined and light severity was obtained about 10000 lux by installing lamp.

Pots irrigation was performed every 2 days. For combating with phyllophagous worm and cotton's white fly, spraying was done by Diazinon pesticide in 2 stages and with the observation of pests, simultaneously. As the leaves start yellowing and crops growth decline, harvest was performed. In the time of final harvest, measured properties were:

- The height of sunflower bush
- Fresh weight of sunflower
- Fresh weight of sunflower stem
- Fresh weight of sunflower crop
- The number of broom rape bushes

All required statistical calculations were analyzed by SPSS, Excel, SAS software.

RESULTS AND DISCUSSION

Height of sunflower: The results of variance analysis showed that the effect of nitrogenous fertilizer type and the amount of nitrogenous type and also interaction of fertilizer type, fertilizer amount on the height of sunflower are significant at 1% level (Table 1). Mean comparison of

Table 1: Variance analysis of the effect of type and amount of nitrogenous fertilizer on the amount of infection of broom rape parasite to sunflower

SOV	df	Mean square				
		Height of host plant	Fresh weight of stem	Fresh weight of leaf	Fresh weight of seed	No. of broom rape
Replication	2	50.440**	73.073**	0.650 ^{NS}	339.560**	2.0432 ^{NS}
Fertilizer type	2	536.800**	1103.820**	419.350**	5970.270**	3.0127**
Fertilizer amount	3	1603.100**	4253.770**	2650.480**	54562.850**	23.1890**
Type × Amount	6	77.170**	263.700**	130.560**	1339.620**	1.8970 ^{NS}
CV (%)		3.844	5.920	14.995	12.448	21.8900

**Significant at 1% level; NS: Not Significant

Table 2: Mean comparison of the effect of nitrogenous fertilizer on measured properties in sunflower and broom rape

Fertilizer type	Height of host plant	Fresh weight of host**	Fresh weight of leaf**	Fresh weight of crop**	No. of broom rape**
Ammonium nitrate	155.38 ^b	115.75 ^a	32.93 ^b	95.04 ^a	7.54 ^a
Urea	160.47 ^a	116.91 ^a	37.10 ^a	109.10 ^a	7.67 ^a
Ammonium phosphate	147.21 ^c	99.75 ^b	25.43 ^c	65.41 ^b	6.43 ^b

Table 3: The effect of nitrogenous fertilizer on measured properties in sunflower and broom rape

Usage herbicide dose (ppm)	Height of host plant	Fresh weight of host stem**	Fresh weight of leaf**	Fresh weight of seed**	No. of broom rape
0	149.38 ^b	82.260 ^d	9.64 ^d	97.95 ^d	6.71 ^a
2	155.31 ^b	107.283 ^c	27.42 ^c	124.73 ^c	6.34 ^a
4	161.77 ^b	120.640 ^b	42.02 ^b	138.54 ^b	5.45 ^b
5	168.18 ^a	133.030 ^a	48.20 ^a	168.19 ^a	4.71 ^b

All numbers which have one common letter are statistically in 1 group; **Based on gram per pot

data showed that the highest height of sunflower bush was obtained in urea treatment (160.47 cm) and the lowest height of sunflower also was observed in ammonium phosphate fertilizer (147.21 cm). Mean comparison of data showed that the effect of nitrogenous fertilizer amount on height of sunflower is significant at 1% level. With increasing of nitrogenous fertilizer concentration, the height of host plant was increased and the highest height of sunflower bush in the concentration of 5 ppm was obtained from nitrogenous fertilizer (168.18 cm) and the lowest height of sunflower bush was seen in control treatment (no-usage of nitrogenous fertilizer) (155.3 cm) (Table 2). The results of mean comparison showed that the effect of interaction of nitrogenous fertilizer, nitrogenous fertilizer concentration is significant on the height of sunflower at 1% and the highest height of sunflower bush was obtained from the concentrations of 4 and 5 ppm of urea fertilizer (176.3 and 173.36 cm, respectively) and both of them were in one statistical group.

Fresh weight of sunflower stem: The results of variance analysis showed that the effect of nitrogenous fertilizer type and nitrogenous fertilizer amount and also the effect of interaction of fertilizer type, fertilizer amount on fresh weight of sunflower stem are significant at 1% level (Table 1). The results of mean comparison showed that the effect of nitrogenous fertilizer on fresh weight of sunflower stem is significant at 1% level (Table 2) and the highest amount of fresh weight of sunflower was observed in ammonium nitrate treatment (116.9 g) and the

lowest amount of it was seen in ammonium phosphate treatment (99.75 cm). Mean comparison of data showed that the effect of nitrogenous fertilizer concentration on fresh weight of sunflower stem is significant at 1% level. With increasing of nitrogenous fertilizer concentration, fresh weight of sunflower was increased (Table 3) and the highest fresh weight of sunflower stem was obtained from nitrogenous fertilizer by concentration of 5 ppm (133.03 g) and the lowest fresh weight of sunflower stem was also seen in concentration of 0 ppm (control treatment) (82.26 g).

The effect of interaction of fertilizer type, the amount of nitrogenous fertilizer on fresh weight of sunflower stem was significant at 1% level (Table 4). The highest fresh weight of sunflower stem was obtained from ammonium nitrate and urea fertilizers at concentration of 5 ppm (141.51 and 141.35 g, respectively) and both of them were in one group. The lowest fresh weight of sunflower shoots was obtained from ammonium phosphate fertilizer at the concentration of 2 ppm (78.91 g) (Table 4).

Fresh weight of sunflower leaf: The results of variance analysis showed that the effect of nitrogenous fertilizer type, nitrogenous fertilizer amount and also the interaction of fertilizer type, nitrogenous fertilizer amount are significant at 1% level (Bioshef and Foroghi, 1985). The results of mean comparison showed that the effect of nitrogenous fertilizer type on fresh weight of sunflower leaf is significant at 1% level (Table 2). The highest fresh weight of sunflower leaf was obtained in urea treatment (37.10 g) and the lowest fresh weight of sunflower bush

Table 4: Mean comparison of data of the effect of interaction of type and amount of nitrogenous fertilizer on measured properties in sunflower and broom rape

Fertilizer types	Usage dose	Host height	Fresh weight of host stem**	Fresh weight of host leaf**	Fresh weight of seed**	No. of broom rape**
Ammonium nitrate	0	136.13 ^f	79.61 ^e	27.33 ^e	24.01 ^e	7.26 ^b
Ammonium nitrate	2	153.73 ^a	117.14 ^c	61.59 ^c	49.58 ^c	6.56 ^d
Ammonium nitrate	4	162.16 ^b	124.74 ^b	95.39 ^b	50.09 ^b	5.70 ^d
Ammonium nitrate	5	169.50 ^b	141.51 ^a	109.26 ^a	58.82 ^b	5.16 ^d
Ammonium phosphate	0	137.50 ^f	86.79 ^e	36.43 ^e	32.12 ^e	8.12 ^a
Ammonium phosphate	2	142.80 ^e	78.91 ^e	45.84 ^d	39.12 ^d	7.45 ^b
Ammonium phosphate	4	149.80 ^e	104.19 ^d	53.06 ^d	52.20 ^c	6.12 ^c
Ammonium phosphate	5	158.76 ^a	116.24 ^c	59.10 ^d	58.05 ^b	5.23 ^d
Urea	0	140.83 ^f	80.39 ^e	29.55 ^d	31.76 ^e	6.45 ^c
Urea	2	151.40 ^d	112.92 ^c	59.01 ^c	44.54 ^d	5.56 ^c
Urea	4	173.36 ^a	133.01 ^b	101.97 ^b	60.40 ^c	5.09 ^c
Urea	5	176.30 ^a	141.35 ^a	108.56 ^a	64.27 ^a	4.20 ^f

All numbers which have one common letter are statistically in 1 group; **Based on gram per pot

was obtained in ammonium phosphate treatment (25.43 g). Mean comparison of data showed that the effect of nitrogenous fertilizer amount on fresh weight of sunflower leaf is significant at 1% level (Table 3). The highest fresh weight of sunflower leaf was obtained from nitrogen fertilizer at concentration of 5 ppm (48.20 g). Generally, with increasing of nitrogenous fertilizer concentration, fresh weight of sunflower leaf was increased. Mean comparison of data showed that the effect of interaction of nitrogenous fertilizer type, nitrogenous fertilizer amount on fresh weight of leaf is significant at 1% level (Table 4). The highest fresh weight of sunflower leaf was obtained from ammonium nitrate (109.26 g) and also from urea fertilizer (108.56 g) at concentration of 5 ppm and both of them were in 1 statistical group.

Fresh weight of seed: The results of variance analysis showed that the effect of nitrogenous fertilizer type, nitrogenous fertilizer amount and also the interaction of fertilizer type, fertilizer amount on fresh weight of glands is significant (Table 1). Mean comparison of data showed the significant difference of fresh weight of sunflower crop between different nitrogenous fertilizer treatments at 1% level (Jamnejad and Baghestani, 2003). The highest fresh weight of crop was obtained in ammonium nitrate and urea treatment (95.04 and 109.10 g, respectively) and both of them were in one statistical group. The results of data comparison showed that there is significant difference of fresh weight of sunflower crop between different treatments of nitrogenous fertilizer amount at 1% level (Jamnejad and Baghestani, 2003). With increasing of nitrogenous fertilizer amount, fresh weight of crop was increased and the highest fresh weight of crop was obtained in 5 ppm (36.81 g). The effect of interaction of fertilizer type, nitrogenous fertilizer amount on fresh weight of crop was significant at 1% level (Table 4). The highest fresh weight of crop was obtained from urea fertilizer at concentrations of 4 and 5 ppm (64.27 and 60.4 g, respectively) and the lowest fresh weight of crop was obtained in the treatment of no-usage of ammonium nitrate fertilizer (24.01 g).

The number of broom rape: The results of variance analysis showed that the effect of nitrogenous fertilizer type and also the amount of nitrogenous fertilizer on the number of broom rape was significant at 1% level but does not have any significant effect on the interaction of fertilizer type, nitrogenous fertilizer amount (Table 1). Mean comparison of data showed that the effect of nitrogenous fertilizer type on the number of broom rape is significant at 1% level (Table 2) and the highest number of broom rape was obtained from urea fertilizer treatment (7.17) and the lowest number of broom rape was obtained in ammonium nitrate treatment (6.43) (Table 2). The results of mean comparison showed that the effect of nitrogenous fertilizer concentration on the number of broom rape is significant at 1% level (Table 3). The number of broom rape was the lowest from nitrogen fertilizer at the concentration of 5 ppm (4.71) and the highest broom rape number was obtained from nitrogen fertilizer at the concentration of 0 and 2 ppm and both of them were in one statistical group (9.71 and 8.52, respectively). Mean comparison of data showed that the effect of interaction of fertilizer type, nitrogen fertilizer amount on the number of broom rape is significant at 1% level (Table 4). The lowest number of broom rape was obtained from urea fertilizer at concentration of 5 ppm (4.24) and the highest broom rape number was also obtained from ammonium phosphate fertilizer at the concentration of 0 ppm (8.12).

CONCLUSION

The results of this experiment showed that the type and amount of nitrogenous fertilizers on growth of sunflower and Egyptian broom rape (*Orobanchae aegyptiaca*) is significant. In general, urea fertilizer had the most effect on the growth of sunflower and caused the increasing of bush height indices, fresh weight of stem, fresh weight of leaf of sunflower and fresh weight of crop and also caused the reduction of broom rape germination.

REFERENCES

- Abu-Irmaileh, B.E., 1981. Response of broom rape (*O. ramosa*) infestation to some nitrogenous compounds. Weed Sci., 29: 8-11.
- Abu-Irmaileh, B.E., 1994. Nitrogen reduces branched broom rape (*O. ramosa*) Seed germination. Weed Sci., 42: 57-60.
- Bedawi, F.F., R.E. Eplee and S.N. Rebecca, 1984. Effect of seed size and weight on witch weed (*Striga asitica*) seed germination, emergence and host parastation. Weed Sci., 32: 202-205.
- Bioshef, F. and M. Foroghi, 1985. The effect of soil PH on the amount of tomato and tobacco infection by broom rape. Report of the Institution of Study of Plant Pests in Tehran, Volume 7, pp: 121-123.
- Foy, C.L., R. Jacobsohn, B. Bohlinger and M. Jacobsohn, 1991. Seasonal Behavior of Broom rape species as Determined by Host Range and Environmental Factors. In: Parasitic Flowering Plants, Ransom, J.K., L.J. Musselman, A.D. Worsham and C. Parker (Eds.). CIMMYT, Nairobi, Kenya, Pages: 454-457.
- Jain, R. and C.L. Foy, 1992. Nutrition effects on parasitism and germination of Egyptian broom rape (*O. aegyptiaca*). Weed Technol., 6: 269-275.
- Jamnejad, M. and M.A. Baghestani, 2003. Study of the effect of temperature on germination of broom rape (*Orobanche aegyptiaca*) in the presence of tomato (*Lycopersicum esculentum*) and tobacco (*Nicotiana tabacum*). M.Sc. Thesis, Agriculture Faculty, University of Tehran.
- Marium, E. and R. Suwanketnikom, 2004. Effect nitrogen fertilizers on broom rape (*Orobanche ramosa* L.) in tomato (*Lycopersicon esculentum* Mill.). Kasetsart J., 38: 311-319.
- Mousavi, S. and P. Shimi, 1997. Parasitic Weed of World. Translation of Islamic Azad University of Varamin, Tehran, Iran, Pages: 389.
- Nandula, V.K., 1998. Selective control of egyptian broom rape (*O. aegyptiaca*) by glyphosate and its amino acid status in related to selective hosts. Ph.D. Thesis, Blacksburg, Virginia.
- Van Hezewijk, M.J., A.P. van Been and J.A.C. Verkeij, 1993. Germination of *O. crenata*, as influenced by conditioning temperature and period. Can. J. Bot., 71: 786-792.
- Westwood, J.H. and C.L. Foy, 1999. Influence of nitrogen on germination and early development of broom rape (*Orobanche* sp.). Weed Sci., 47: 2-7.