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EFFECT OF SUPER-ABSORBENT TREATMENT ON SOYBEAN YIELD

Ali Taheri Amiri[1*], Hossein Sharifan[2], Mousa Hesam[2] and Morteza Siavoshi[3]
[1]M.Sc. Student, University of Agriculture and Natural Resources, Gorgan, I.R. of Iran
[2]Associate Prof., University of Agriculture and Natural Resources, Gorgan, I. R. of Iran
[3]Assistant Prof., Department of Agricultural Science, Payame Noor University, I. R. of Iran.
(*Corresponding author E-Mail: taheri53ali@yahoo.com)

ABSTRACT
In order to consider effect of super-absorbent treatment on soybean yield, an experiment was carried out in 2011, at Galougah, Mazandaran, Iran. Amount of four colophony super-absorbent polymers (0, 2, 4 and 6 g/kg soil) with three irrigation levels (50%, 75% and 100% crop water requirement) were applied in thirty-six pots. The B.P was variety of soybean. Characters like Plant height, total number of pod, number of seed per pod, 100 seeds weight and seed yield were considered in this experiment. There was significant difference between water stresses and super-absorbents treatments. Use of 4 g/kg soil super-absorbent demonstrated better effect on growth and soybean yield.

KEYWORDS: soybean yield, super-absorbent, water stress.

INTRODUCTION

Arid and semiarid lands affected in most regions of Iran country, especially water deficiency increased recently doughtiness. Each plant needs water to grow and produce even in greenhouse condition. Crops faced with drought stress if their water requirements didn't provide and some periods like seed germination and flowering will damaged, so it caused to reduce yield. Crop residues, poultry manure, compost and super-absorbent polymer hydrogels can save different amount of water and they are able to keep and save more water in soil. When water is shortage, saved water will be accessed for plant (Chatzopoulos *et al*., 2000). Super-absorbent polymers are able to absorb 200 to 500 mLit water for each gram of polymer dry weight (Bowman and Evans, 1991). Super-absorbent soaks water up fast and considerable amount in its structure. Research on super-absorbent showed successful effect under water deficiency condition. Super-absorbent polymers use in water filtration, wastes, food industrials, textile and mining (Orzolek, 1993 and Barvenik, 1994).

Water deficiency is first limitation of soybean production in semiarid region. So more yield should be obtained by choosing strong and compatible cultivar for arid and semiarid region. Several approaches have been used to select drought tolerance in soybean like yield measuring under drought stress during the growing season (Soliman-Mona, 2003.), genotypes evaluated in controlled environments such as greenhouses and laboratories (Samnonsa, 1979 and Samnonsa, 1980), use of supplemental irrigation water to create different environments in order to compare the genotypes presentation (Samnonsa and Himowitz, 1980).

MATERIALS AND METHODS

The experiment was carried out in 2011, at Galougah, Mazandaran, Iran. Thirty six pots were arranged as a split plot in randomized complete block design based on 3 replications which each pot bear 6 kg soil. In this experiment, three irrigation levels (50%, 75% and 100% crop water requirement) were chosen as a main factor and four colophony super-absorbent polymers (0, 2, 4 and 6 g/kg soil) as a sub-factor. Before planting 3 kg soil without super-absorbent added in bottom of pot then the other 3 kg were mixed by super-absorbent, after that soybean planted. Other treatments like soil tissue, nutrient, insect, disease control and etc were managed similar. Parameters like Plant height, total number of pod, number of seed per pod, 100 seeds weight, harvest index, biological and seed yield were sampled and considered from each pot in this experiment. The data were analyzed with SAS software. Mean comparison calculated by method of Duncan's multiple range tests at the 0.05 significance level.

RESULTS

Plant height (cm)

Analysis of data showed that plant height was significant under drought stress, super-absorbent and their interaction in 1 % probability level (Table 1). Highest plant height (66.58 cm) obtained in without stress and shortest (56.92 cm) in 50 % stress (Table 2). Maximum plant height (65.89 cm) found by 6 g/kg soil and minimum (54.56 cm) in control. Interaction between without stress treatment and super-absorbent 4 g/kg soil demonstrated greatest plant height (67.33 cm) and smallest (42 cm) between 50 % stress and control.

Total number of pod

In statistical point of view total number of pod illustrated significant difference under stress, super-absorbent and their interaction in 1 % probability level (Table 1). The highest number of pods stresses condition with the 74.08 and the lowest number of pods in the amount of 50% strain 64.08 was achieved. The highest number of pods (73.56 numbers) with the lowest dose of 6 g/kg of soil and number of pods in the control treatment (61.78 numbers) were obtained. Interaction between stress and non-stress treatments superabsorbent showed the highest number of pods and 4 g/superabsorbent/kg soil with the lowest number of 75 (50%) and stress pod treated superabsorbent without (control) with the 51.33 number of was obtained (table 4).

Number of seed per pod

Analysis of variance of the measured data showed that pod yield under drought stress and super absorbent surfaces and their interaction were the one percent level (Table 1). Stress condition with the 2.64 number in 50% yield and stress the value of 1.95 the lowest number of seeds per pod was obtained. Maximum dose of 6 g/kg of seed, with the 2.54 and the minimum number of seeds in control treatment (without superabsorbent) with the 2.07 was obtained. The interaction between stress levels and superabsorbent most seed treatments 25% strain and 6 g/superabsorbent/kg soil with the 2.7 and the minimum number of seeds treated with 50% stress without the use of superabsorbent (control) with 1.5 was obtained (table 4).

100 seeds weight (g)

Analysis of variance showed that seed weight under significant stress and super absorbent surfaces and their interactions were significant at the one percent level (Table 1). Maximum grain weight under irrigated with 16.45 g in weight and 50% less friction with the 15.13 g was obtained. The maximum dose of 6 g/kg soil, with 16.19 g and lowest weight control treatment (without superabsorbent) with 15.41 g was obtained. The highest grain yield in non-stress interaction and 6 g/superabsorbent/kg soil treated with 16.57 g (50%) and lowest grain yield in stress and non-use of superabsorbent treated (control) with 14.5 g was obtained.

Grain yield (kg/ha)

Significant grain yield under stress and super absorbent surfaces and their interaction showed a significant difference in the level of one percent (Table 1). Stress condition with the highest grain yield of 3448 kg/ha and 1829 kg/ha in terms of the minimum yield stress of 50% was achieved. More performance with a dose of 6 g/kg soil, with the lowest yield of 2948 kg/ha and the control treatment (without superabsorbent) was obtained with a value of 2534 kg/ha. Interaction between the yield stress and super absorbent showed the highest yield in non-stress treatment and 6 grams of superabsorbent per kg soil with 3488 kg/ha and the minimum yield stress of 50% of the treated superabsorbent and without (control) was obtained with a value of 1538 kg/ha (Table 4). The main reasons for the decrease in the yield stress of dehydration, decreased during the growing season, reduced levels of photosynthetic organs (leaves), reducing the number of flowers (of reproductive organs) and grain weight (due to reduced transmission of assimilation and photosynthesis).

Biological yield (kg/ha)

Analysis of variance of the measured data showed that the biomass yield under stress and super absorbent surfaces and their interactions at the level of one percent was (Table 1). Stress condition with the highest yield (6486 kg/ha) and was obtained in 3470 kg/ha to 50% in tension with the lowest biological yield. More performance with a dose of 6 g/kg soil, with the lowest yield (5474 kg/ha) and biological control treatments (without superabsorbent) was obtained with a value of 4898 kg/ha. Most of the interaction of stress and super absorbent 4 g/kg soil with the lowest yield (6487 kg/ha) and 50% of the treated superabsorbent tension and without (control) was obtained with 2998 kg/ha (Table 4).

Harvest Index (%)

The total number of pods per plant was significant only in one percent of superabsorbent levels showed no significant differences (Table 1). Super absorbent effect on harvest index showed a mean maximum dose of 6 g/kg soil, with the 53.78 % and lowest in the control treatment (without superabsorbent) with 51.67 % respectively.

DISCUSSION

Dehgan *et al*. (1994) observed that in the 0.75 % by volume mixture of polymer clay, polymer production rate of dry matter in the soil has been no way to test conclude that this part of the consumer save up to 50% of the water samples were obtained using polymer. In a study on the effect of reducing the dry superabsorbent hydro-gels olive trees were the results showed significant differences between treatments are likely to be less than 1%. Generally, the use of 0.3 % weight superabsorbent polymers, the growth of the seedlings were increased by the treatment relative to the control and drought stress was less likely (Talaee and Asadzadeh, 2005). A comparative study effect of drought stress on 6 genotypes of canola and super absorbent hydro-gel showed that drought stress reduced photosynthesis and chlorophyll content were observed. This super absorbent polymer can absorb the harmful effects by water shortages, water conservation is significantly reduced. We also observed that increased performance and decreased water requirements of the superabsorbent polymer was announced. Stocker (Stocker, 1960) reported that drought stress reduced the length of the main stem of the plant may be stunted state. Because of the reduced number of pods per stem growth can be reduced under drought stress and stem height was observed in this experiment. Yazdani *et al*. (2007) showed that with increasing amount of each super absorbent cause to increase grain yield, grain weight, number of pods, seed yield, and seed protein content.

Table 1. Analysis and variance of stress effect and superabsorbent on grain yield and its component in soybean cultivar (B.P).

S.O.V	D.F	Plant height	Total number of pod	Number of seed per pod	100 seeds weight	Grain yield	Biological yield	Harvest Index
Stress(A)	2	280.361**	306.25**	1.481**	5.403**	8527642.861**	29531058.861**	1.00 ns
error	6	4.833	0.583	0.013	0.022	13796.806	77884.833	0.833
Super absorbent (B)	3	245.704**	278.148**	0.409**	1.127**	323071.778**	656012.324**	8.519**
A*B	6	78.954**	69.278**	0.092**	0.15**	66718.417**	237804.824**	0.074 ns
error	18	2.537	0.657	0.003	0.004	2001.176	11002.907	0.278
C.V %	-	2.58	1.18	2.28	1.42	1.61	2.01	1.99

*and ** significant in 5 and 1% level respectively.
ns means no significant

Table 2. Mean comparison of simple effect stress on grain yield and its components in soybean cultivar (B.P).

Stress effect	Plant height	Total number of pod	Number of seed per pod	100 seeds weight	Grain yield	Biological yield	Harvest Index
No stress	66.58 a	74.08 a	2.64 a	16.45 a	3448 a	6486 a	53.17 a
Stress 25 %	61.83 b	67.83 b	2.44 b	16.02 b	3048 b	5726 b	53.17 a
Stress 50 5	56.92 c	64.08 c	1.95 c	15.13 c	1829 c	3470 c	53.67 a

Same letters are not significant.

Table 3. Mean comparison of simple effect super absorbent on grain yield and its components in soybean cultivar (B.P).

Super absorbent effect	Plant height	Total number of pod	Number of seed per pod	100 seeds weight	Grain yield	Biological yield	Harvest Index
control	54.56 c	61.78 c	2.07 d	15.41 d	2534 c	4898 c	51.67 c
2 g	61.33 b	66.56 b	2.27 c	15.77 c	2708 b	5117 b	52.89 b
4 g	65.33 a	72.78 a	2.48 b	16.1 b	2911 a	5421 a	53.67 a
6 g	65.89 a	73.56 a	2.54 a	16.19 a	2948 a	5474 a	53.78 a

Same letters are not significant.

Table 4. Mean comparison of interaction between stress levels and super absorbent on grain yield and its components in soybean cultivar (B.P).

Stress * super absorbent	Plant height	Total number of pod	Number of seed per pod	100 seeds weight	Grain yield	Biological yield	Harvest Index
A1B1	66 a	72 cd	2.6 a	16.33 d	3395 bc	6531 a	52 cd
A1B2	66 a	74.67 ab	2.66 a	16.4 bcd	3427 ab	6468 a	53 ab
A1B3	67.33 a	75 a	2.63 a	16.5 ab	3481 a	6487 a	53.67 ab
A1B4	67 a	74.67 ab	2.66 a	16.57 a	3488 a	6459 a	54 a
A2B1	55.67 c	62 f	2.13 d	15.4 g	2669 f	5166 d	51.67 d
A2B2	61.67 b	65.67 c	2.3 b	15.83 c	2873 c	5421 c	53 ab
A2B3	64.33 ab	71 d	2.63 a	16.37 cd	3305 d	6121 b	54 a
A2B4	65.67 a	72.67 d	2.7 a	16.47 abc	3346 cd	6196 b	54 a
A3B1	42 d	51.33 h	1.5 f	14.5 i	1538 i	2998 g	51.33 d
A3B2	56.33 c	59.33 g	1.86 c	15.07 h	1824 h	3463 f	52.67 bc
A3B3	64.33 ab	72.33 cd	2.2 cd	15.43 fg	1947g	3653 e	53.33 ab
A3B4	65 a	73.33 bc	2.26 bc	15.33 f	2009 g	3766 e	53.33 ab

Same letters are not significant.
A1, A2, A3 means control, 25 and 50 % stress.
B1, B2, B3, B4 means control, 2, 4 and 6 g/kg super absorbent in each pot.

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