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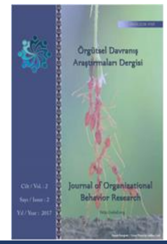

Studying the Effect of Under-Irrigation and Potassium Fertilizer on Soybean Yield

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ABSTRACT

This experiment on soybean yield and yield components was conducted in 2002 using a randomized full block design with split plots and three replications. The primary factors of under-irrigation are s3 (optimal irrigation as a control), S2 (water cut from the beginning to the end of podding), and S (water cut from the beginning to the end of flowering), as well as the secondary factor of potassium fertilizer at three levels of zero (K0), 50 (K50), and 100 (K100) kg K20 per hectare. The control treatment (S) produced the highest grain yield of 4168.2 kg/ha, whereas stress in the flowering stage produced the lowest yield of 4426.6 kg/ha (S1). The greatest grain yield was 3502.2 kg/ha in the K50 treatment, whereas the lowest grain yield was 3159 kg/ha in the KO treatment. Grain yield rose as the number of grains in the pod grew, according to the findings. The harvest index was highest in the optimal irrigation condition, and when drought stress was applied from blooming to pod stage, the harvest index dropped from 26.1 to 21.6 percent. The number of pods per plant and grain weight was the yield components that were most susceptible to stress. The number of grains per pod, for example, exhibited a rather high level of stability and was unaffected by drought stress treatments or potassium fertilizer. S3 treatment had the highest grain yield, harvest index, biological yield, and leaf area index among the stress treatments, whereas S1 treatment had the lowest grain yield, harvest index, and biological yield. According to the findings, the K50 fertilizer treatment had the most seeds, pods per plant, seeds per pod, harvest index, biological yield, and grain yield among the fertilizer treatments, while the KO treatment had the least of these characteristics.

Keywords: *Potassium fertilizer, Moisture stress, Biological yield, Soybean*

INTRODUCTION

Soybean is an oil seed that has been grown in China since approximately 2800 BC and is regarded as a holy plant in the country. Glycine | ussuriensis is most likely the source of soy (Khajehpour, 1984). Glycin Min's origins and origins are unknown; however, soy is widely available in East Asia. From East Asia to Northeastern North China and North Central China, there are many hypotheses concerning a Pure Genesis Center for Soybeans. Himowitz is a well-known figure in the world (1970). The base of soybeans was established in the eleventh century BC, as evidenced by visual indications for the Chinese term soybean (evil) in the Book of Addis in the form of a brass inscription (Kouchaki et al., 1993). While soybeans were a significant crop in the United States before 1880, by 1930, the United States had produced nearly 75% of the world's soybeans, with China coming in second with 17%. More than half of US goods are sent to Europe; soy has a long history of use as a staple meal in the Far East, including exports to Japan and Canada. However, in the West, this plant's whole output is mostly employed in manufacturing and extraction. Although soybean is consumed, the majority of it is extracted oil (90 percent in the US) and consumed as food, with nearly all of its protein (98 percent in the

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US) used to augment animal feed. Similar applications for this product have evolved in the Far East's industrial sectors in recent years (Majnoon Hosseini, 1997).

Climate change, management, crop season, and soil type will all affect soybean water usage. During the growth season, certain studies, such as Dorn Yus et al. (1989), have documented the rate of evapotranspiration of soybeans according to climatic parameters for maximum output, ranging from 0-450 mm (Anonymous, 1986). Whereas Pald (1987) reported soybean irrigation water from 1200-600 mm, indicating that soil conditions (suitable clay and sandy soil), climate, and variety have a significant effect on water consumption by this plant (Anonymous, 1375), Farsh et al. (2000) estimated the pure water needed for soybeans in the Boroujerd and Lorestan regions at 7500 cubic m^3/h for 100 percent production.

Irrigation of soybeans in rainfed circumstances enhanced the number of pods developed in the branches formed in the lower nodes of the plant, according to Wallis et al. (1986). Despite the fact that nodes 3-3 and 9-9 of the main stem generated the most pods, stress reduced the number of pods in the main stem nodes, particularly the lower and frontal nodes, by increasing the fall and pods (Wallace, 1986). The decrease in the number of pods at plant nodes was also attributed to the leap of pods and flowers, according to Hindel and Brann (1984). Drought stress caused pod shedding and dormancy, which lowered the ratio of grain weight to pod weight by lowering the synthesis of photosynthetic components and impairing material transfer. With increased stress levels, grain weight also reduced dramatically. As a result, a dramatic fall in the number of grain weights was the cause of the loss in grain yield at stress levels (Heindl, W. A Bran. 1984). Moisture stress during the blooming stage of soybeans reduces flowering period duration, number of flowers, number of pods, number of seeds, and seed weight, according to Zionite and Kramer (1977). (Sionit and Kramer, 1977). Moisture stress has a major influence on the performance of seria and its components, according to Khodambashi et al. (1987). According to Daneshian et al. (1999), moisture stress in the R1-R2 stage (flowering stage) resulted in the largest yield drop (80%) in soybeans. Drought stress during soybean flowering increased the weight of 1000 seeds, according to Froud and Mendel (1993). The reduction in yield caused by pod stage stress was attributed to a rapid drop in the number of seeds per plant and the weight of 1000 seeds. The goal of this study, as stated above, was to look into the impacts of potassium on the quantitative and qualitative features of soybeans under moisture stress.

Materials and methods

This experiment is carried out in the form of a randomized complete block design with split plots in three replications per 81 crop year in Lorestan Agricultural and Natural Resources Research Center, Sarab Changai Station, Khorramabad, with a longitude of 48 ° 18 ′ and latitude of 33° 30′ and 1171 meters above sea level. The 81-80 crop year saw 585 mm of rainfall, an absolute maximum temperature of 47.4 ° C, an absolute minimum temperature of -14.6 ° C, 28.5 frost days, and an annual evapotranspiration rate of 1033 mm. The experimental design was split plots with three replications, with the main factor of under-irrigation at three levels, including cessation of irrigation from the beginning of flowering to the end of flowering (s1), cessation of irrigation from the beginning of podding to the end of podding (S1), and control (S3), and the secondary factor of fertilizer application at three levels of zero, 50, and 100 kg/ha K2O as the source of randomized complete block type.

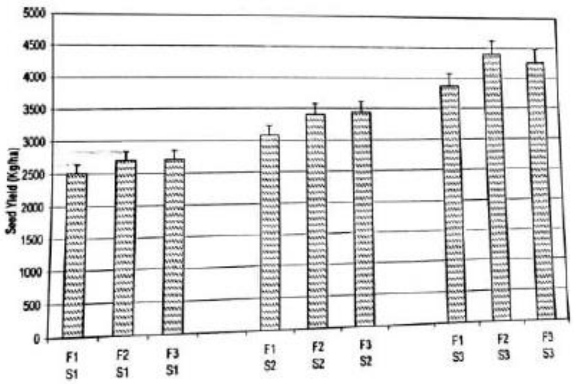
Features of iterations

Each block had 9 garrets with a one-meter spacing between them, and each plot had 6 planting lines with a half-meter spacing between them. The block was 20.5 × 6 meters long and 3 meters wide, with a gap of 3 meters between them. The land was fallow before the trial. Two plows were created perpendicular to each other to prepare the planting bed. The area was next prepared as an atmosphere and ridge by furrow, according to the test plan, and then the major streams for irrigation were made by a streamer, and the plots were ready for planting.
Until blooming, all plots were watered uniformly every seven days. Irrigation was discontinued at the start of blooming in the S treatment, i.e., R1 from start to finish, and R2 and irrigation were done in the S2 and S1 treatments. Irrigation was discontinued in S2 treatment, i.e., from the commencement of podding (R3) to the conclusion of podding (R4), and irrigation was performed in treatments after this stage (R2-R1) (S1-S3).
In the three-leaf stage, the bushes were shortened to reach a proper space between the rows for each treatment. In this manner, a stick with a diameter of roughly 2 cm was placed next to each planting line, on which the appropriate distances were miraculously marked. Between the markings, garden shears were used to clip shrubs neatly.
Before planting, all phosphorus fertilizers were applied at a rate of 150 kg/ha, with half of the fertilizer applied at a rate of 100 kg/ha. Potassium fertilizer was placed in the center of the soil at the same time as planting at a depth of 1 to 12 cm and roughly 8 cm under the seeds, according to the Kurdish treatment plan.

Results and discussion

Reduced water moisture in the S3 treatment compared to the S2 treatment (interrupted irrigation from the beginning to the conclusion of podding) resulted in a substantial drop in grain yield of 859.7 kg/ha (Figure 1). The moisture decrease in S1 Neymar reduced grain average yield more than the S2 treatment. Since there are more nodes in the tail pod stage (S) than there are in the flowering stage (F), the plant has a better chance of producing a large number of florets (S1). Despite the fact that it lacks pod sheaths, it may compensate for this limitation by relying on the numerous nodes that carry the pods. Furthermore, flowering stress leads the plant to grow fewer branches, resulting in fewer seeds and pods per plant but a greater 1000-seed weight since photosynthetic material is distributed between the number of pods and fewer seeds.
Moisture stress during the blooming phase, according to Zionite and Kramer (1977), shortened the length of the flowering period by the total number, pod number, and the number of soybeans. More measurable parameters such as number of tubers per root, plant height, number of seeds, yield, percentage of oil, and protein in soybean rose as water consumption increased, according to Saadati and Yazdi Samadi (1977). Moisture stress has a considerable impact on soybean yield and its components, according to Khodambashi et al. (1987). The fall of pods and flowers, according to Mindell and Brann (1984), caused a decrease in the number of pods in plant nodes. Drought stress lowered the ratio of grain weight to pod weight by lowering the synthesis of photosynthetic materials and impairing the transfer of toaster materials, resulting in pod and seed abortion. With increasing stress intensity, grain weight also decreased significantly, implying that the loss in grain production in the stress scheme was due to a decrease in the quantity and weight of grains.
According to Daneshban et al. (1999), the application of moisture stress during the blooming stage resulted in the largest yield drop (80%) in soybeans. This suggests that by raising potassium fertilizer to 50 kg per hectare, grain output may be increased by increasing the number of seeds

per plant. Alternatively, via osmotic adaptation, the plant can take more water from the root through a potential slope when there is less potassium in the plant tissues or when sweating is reduced.



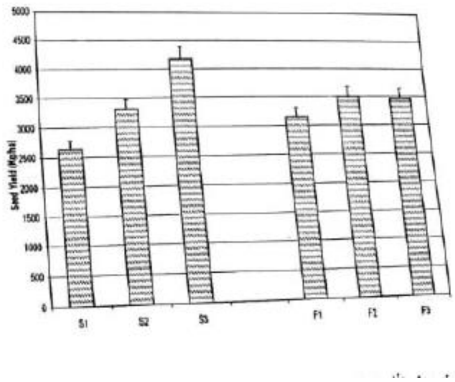


Figure 1. The effect of moisture stress and potassium fertilizer on soybean yield

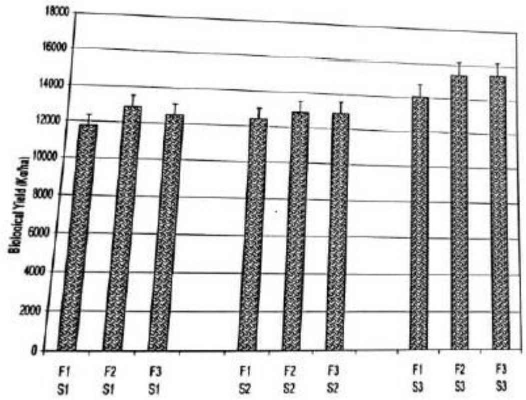
Figure 2. Interaction of moisture and potassium fertilizer on grain yield

Biological function

Because S1 was 360.7 kg lighter than S2, there was no significant difference between the two treatments (Figure 3). This might be attributable to an increase in the dry weight and 1000-grain weight. Drought stress during stage R2 decreased the number of seeds in subsequent stages of reproductive development, according to C. Cyclas et al. (1992). Furthermore, as compared to the control, applying stress at R2 reduced plant dry weight.

Etio et al. (1991) found that dry weight dropped with the start of drought stress in all regions of the plant in a study of the effects of drought stress on soybeans. Although there was no significant effect of fertilizer on biomass, Figure (4) displays that the amount of fertilizer to the level of 50 Kgh increased the mean biomass to 13724.1 Kg / h, which there was a significant difference between not consuming potassium (Ko) at the rate of 12761.1 Kg / h, but there was no significant difference compared to 100 kg at the rate of 13615.2 kg / h.

Sharma et al. (1992) found that using potassium under moisture stress averted considerable grain and dry matter yield reductions. Even minor K deficit impacts photosynthetic activity and dry matter formation in plants where the photosynthetic material transfer is regulated by potassium levels, according to Jin Zinping et al. (1987). In the S2 treatment, there was no statistically significant difference in biological performance between different quantities of potassium fertilizer, as shown in Figure (4).



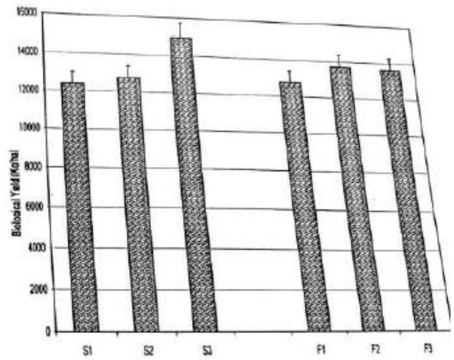


Figure 3. The effect of moisture stress and potassium fertilizer on biological performance
Figure 4. Effect of moisture stress and potassium fertilizer on biological yield

Straw yield

The best straw production was associated with treatment S1 at 10.10805 kg/ha, while the lowest was associated with S2 treatment at 9430.4.4 kg/ha, a significant difference. However, the S2 therapy yielded 303.3 kg less than the S1 treatment, which was not a statistically significant difference. Under stress, reproductive growth appears to be more responsive to stress than vegetative growth, and straw output has not fallen as much as grain yield.

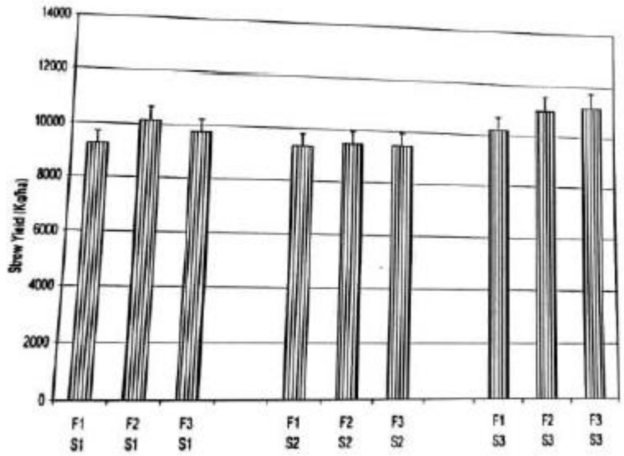
Most of the measured parameters, such as number of tubers per root, plant height, number of seeds per pod, grain yield, oil percentage, and protein in soybean, rose as water consumption increased, according to Saadati and Yazdi Samadi (1977).

More size parameters, such as number of tubers per root, plant height, number of seeds per pod, grain yield, oil content, and protein in soy, rose with higher water consumption, according to Di Samadi (1980).

Figure (5) demonstrates that applying up to 50 kg/ha of potassium fertilizer boosted straw production by 92.921 kg/ha, a substantial improvement from Neymar KO's output of 9.6060 kg/ha. However, when compared to treatment of 100 kg/ha, which yielded 10142.1 kg/ha, there was no significant difference.

This is owing to the fact that using potassium fertilizer in drought-stricken areas might enhance straw production to a point, and then increasing potassium fertilizer use without improving straw output. It will also reduce the amount of straw produced. The explanation for this may be attributed to the plant's genuine requirement for physiological processes to generate straw under drought stress circumstances, which was supported by the findings of other researchers.

In a study of drought stress on soybeans, Etio et al. (1991) found that when soil water decreased, the potassium content of leaves in all regions of the stem increased fast, causing the water potential in the vessels to fall below the water potential. The occurrence of stress resulted in a loss of dry weight in all regions of the plant; with increased stress, more potassium was collected in all of the plant's higher portions.



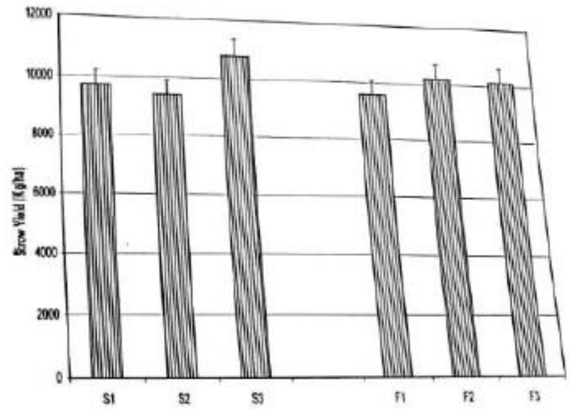
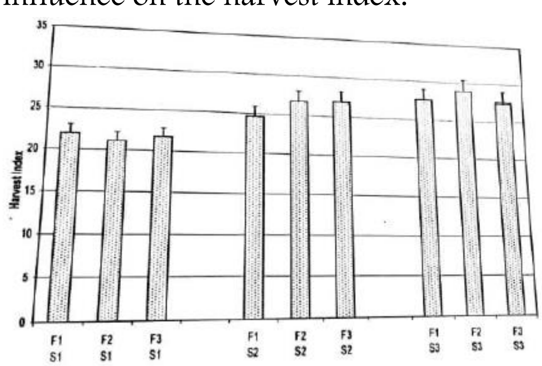


Figure 5. Effect of moisture stress and potassium fertilizer on straw yield
Figure 6. Interaction of moisture stress and potassium fertilizer on straw yield

Harvest index

Figure (7) demonstrates that the greatest harvest index in the S1 treatment is 28 percent, while the lowest is connected to the S2 treatment (29.16 percent), both of which have a statistically significant difference, and that the S1 and S2 treatments have a statistically significant difference (26.1). The reason for this is that while the yield in the S2 treatment was sometimes lower than in S1, the grain yield was higher; therefore, the harvest index of the S2 treatment was higher than Neymar S1. Furthermore, at this time, the rise in potassium raises the harvest index. The harvest index of the S1 treatment was greater than the S2 treatment because the plant had optimal growth in the S1 treatment and its grain yield was lower than the S1 treatment's grain yield. As a result, the harvest index of the S1 treatment was higher than the S2 treatment.

In irrigation circumstances, Fisher et al. (1979) found a clear association between drought sensitivity index and features including harvest index, number of seeds per square meter, number of seeds per wheat spike, and leaf water potential when comparing normal and stress conditions. However, there was no relationship between these qualities and the Ssi (drought sensitivity) index when it came to stress. According to Figure (7), the greatest harvest index was associated with F2 treatment at 25.9%, while the lowest was associated with F1 treatment at 24.7 percent, both of which are not statistically significant, implying that high fertilizer has had little influence on the harvest index.



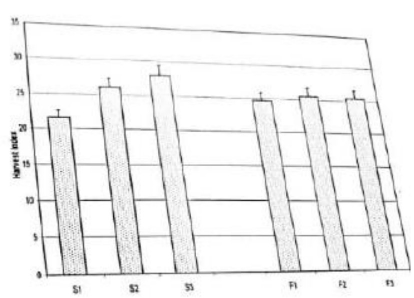


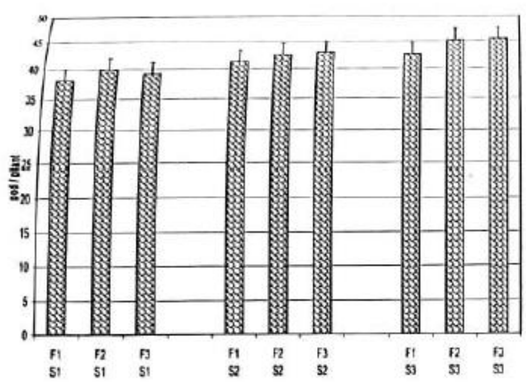
Figure 7. Effect of moisture stress and potassium fertilizer on harvest index
Figure 8. Interaction effects of moisture stress and potassium fertilizer on harvest index

Number of pods per plant

There is a considerable difference between treatments, as seen in Figure 9. Since moisture stress in the S1 treatment lasts until the end of blooming, more flowers fall than in the S2 treatment. By minimizing drought stress, the plant, on the other hand, is unable to generate blossoms. As a consequence, after the plant has produced adequate vegetative growth and moisture stress, the number of pods produced is lower than in the S2 treatment. Despite the fact that the pods are shed at this stage, it yields more pods than the S1 treatment. Plant growth and height have been lowered as a result of moisture stress in the blooming stage compared to the pod stage. As a result, fewer flowers and pods are produced.

In the reproductive developmental stage, Egley et al. (1985) viewed the rivalry of vegetative organs with reproductive organs, as well as the loss of photosynthesis in the plant community, as lowering the number of pods and seeds per unit area. Irrigation of soybeans in rainfed circumstances enhanced the number of pods developed in the branches formed in the lower nodes of the plant, according to Wallace et al. (1986). The number of pods in the major stem nodes, particularly the lower and upper nodes, was reduced only by flower and pod stress. Water stress reduced the number of pods and daisies in the majority of the cultivars studied, according to Karimi (1979). The number of seeds per pod was determined by the dry weight of pods and seeds, as well as the grain wall.

The average (Figure 9) demonstrates that the quantity of fertilizer used up to 50 kg/h differed considerably from not using fertilizer.



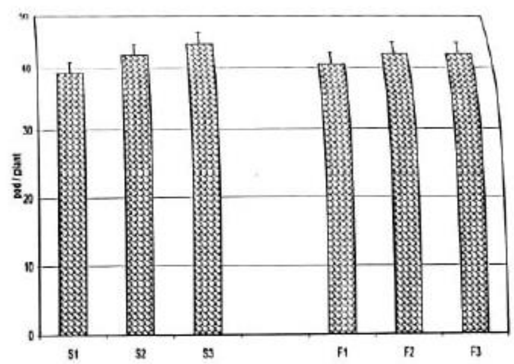
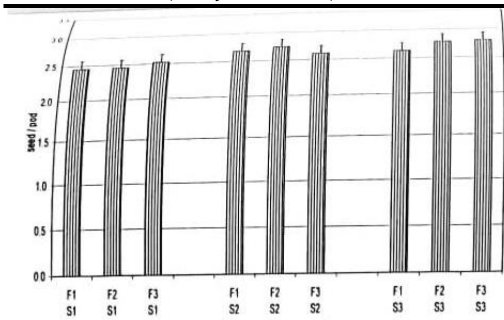


Figure 9: Effect of moisture stress and potassium fertilizer on the number of pods per plant

Figure 10: Interaction of moisture stress and potassium fertilizer on the number of pods per plant

Number of seeds per pod

Figure 11 shows that the S2 treatment has the most seeds per pod, whereas the S1 treatment has the least, indicating that there is a substantial difference between the treatments. In addition, the collapse of the florets, which had a lesser number of seeds per pod at this stage than Neymar S2, caused a decrease in the number of seeds in the flowering stage. Figure 11 reveals that the S2 treatment had the greatest difference in the number of seeds per pod (2.7), whereas the S1 treatment had the smallest difference (2.5), but it was not different from the S2 treatment. However, because the grain yield of the S treatment is larger than the grain yield of the S2 treatment, it is determined that grain yield has a moderate (517%) connection with pod number.



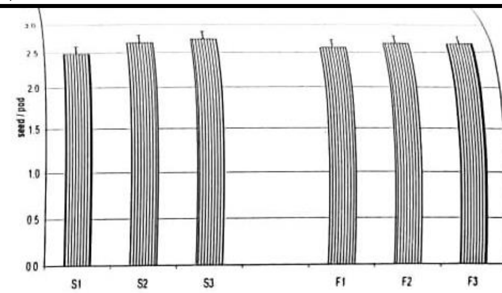


Figure 11. Effect of moisture stress and potassium fertilizer on the number of seeds per pod
Figure 12. Interaction of moisture stress and potassium fertilizer on the number of seeds per pod

Conclusion

In the Khorramabad area, the flowering stage was more vulnerable to drought stress than the pod stage. In summary, it appears that increasing the degree of drought stress increased the effectiveness of potassium up to level 50 in avoiding yield decline and yield performance in the Khorramabad region. The best performance was associated with the control treatment (no stoppage of irrigation) and node at level 50, according to the findings.

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