# THE EFFECT OF VARIOUS SOIL WATER REGIMES ON YIELDAND YIELD COMPONENTS OF MUNG (*PHASEOLUS AUREUS*)

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Response of three mung varieties viz; S—64, 6601 and S233 to various levels of soil moisture stress was studied. Following three levels of soil moisture were tried.

1. 50 per cent field capacity (optimum soil moisture)
2. 37.5 per cent field capacity (First level of stress)
3. 25 per cent field capacity (second level of stress)

Characters like, number of pods per plant, number of grains per pod, 100-grain weight and yield were studied. It was observed that the diminishing levels of soil moisture adversely affected all these characters. Both number of grains per pod and 100-grain weight were significantly reduced. However, the grain number was more seriously affected as compared to their weight. Since these two characters are the major components of yield, reduced amounts of yield were also obtained under progressively increasing levels of soil moisture stress.

## INTRODUCTION

Mung (*Phaseolus aureus*) is one of the major sources of plant proteins. The crop being sensitive to even slight imbalance between moisture up-take and transpirational losses, suffers drastic curtailment in grain yield under conditions of moisture stress. This reduced productivity is caused mainly by an adverse effect of moisture stress on some major components of yield. Whereas, most of the commercial strains exhibit unproductive growth on rich irrigated lands and are inherently low grain yielders. Thus the planting of this important edible legume has no charm for the farmers on rich as well as marginal and moisture stricken lands. The objective of the present investigations was to determine the effect of different water regimes on characters like number of pods per plant, number of grains per pod and 100-grain weight which happen to be more intimately related to the final attribute, the yield. The extent and type of changes in these characters

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under various levels of soil moisture stress, will provide a reliable basis and index for breeding and selection of better adapted legume varieties not only for drought affected areas of West Pakistan, but will also help in improving legume production on rich irrigated lands.

## REVIEW OF LITERATURE

Moisture sensitivity in legumes is well established. Burman and Bohmont (1961) studying the effect of soil moisture levels on great northern beans reported that there was considerable reduction in number of pods per plant under water stress conditions. The wet pots produced a greater number of pods and beans per plant. Positive correlation between seed size and water supply in different phaseolus strains was reported by Quinones (1965). Timmons, *et. al.* (1967) also concluded from their experiments on soyabeans that moisture stress reduced 100-grain weight and consequently reduced yield per plant. Similarly, three levels of irrigation were tried on soyabeans by Khan and Ali (1969). They found that application of 27 acre inch irrigation significantly increased the number of pods and seed yield per plant as compared to 21 or 18 inches. Bean plants were grown in weighing lysimeters to determine their response to different water regimes by Maurer, *et al.* (1969). It was observed that plants irrigated when soil moisture fell to 88 per cent of available soil moisture produced more pods than those irrigated at 60 per cent or 33 per cent of the available soil moisture. Moisture stress was observed to cause a significant reduction in the number of grains per pod in mung bean, by Ishii (1969). The counts being 6.2 and 5.1 grains per pod under high and low moisture conditions respectively. Rawitz and Hillel (1969) also observed an appreciable decrease in the yield of *Phaseolus vulgaris* with progressive soil moisture stress. This reduction emanated mainly through the adverse effect on chrracters like pods per plant, number of grains per pod and grain weight.

## MATERIALS AND METHODS

The experimental material consisted of three varieties of mung viz; S 64, 6601 and S 233, having different growing habits and moisture requirements. The crop was raised in china clay pots filled with 25 lbs. of well mixed and sieved field soil. Fifteen seeds were dibbled in each pot. Planting was done on 25th July for Kharif crop 1971 and 2nd March for Spring crop of 1972. On emergence, a uniform stand of five seedlings per pot was maintained throughout the growth period. Ten pots were raised for each variety and treatment. Following three levels of soil moisture were tried for each variety :-

1. 50 per cent field capacity (Optimum soil moisture)

2. 37.5 per cent field capacity (First level of stress)
3. 25 per cent field capacity (Second level of stress).

Moisture level in the pots was maintained by soil moisture analysis on alternate days and the deficit was restored through surface irrigation. Soil surface of the experimental pots was covered with one inch thick layer of river sand to avoid excessive surface evaporation. The experimental population was raised under normal agronomic and plant protection measures. Data on following characters was recorded and analysed using Duncan's New Multiple Range Test :-

## NUMBER OF PODS PER PLANT AND NUMBER OF GRAINS PER POD

All pods were picked and counted from ten randomly selected plants, one from each pot of every treatment and variety. They were threshed separately and number of grains per pod was calculated using the following formula :-

$$\text{Number of grains per pod.} \quad \frac{\text{Total number of grains per plant}}{\text{Total number of pods per plant.}}$$

## 100—KERNEL WEIGHT

Hundred grain weight was recorded by taking five random samples of 100-grains from the total yield of all the selected plants in each variety and treatment. Mettlers electric balance was used for these estimations.

## YIELD

Yield per plant was recorded by individually weighing the total amount of seed obtained from ten randomly selected plants, one from each pot of every treatment and variety.

## RESULTS AND DISCUSSION

A generalized picture of the trends obtained through this research clearly indicates that the diminishing levels of soil moisture adversely affected almost all the characters direcly related to the yield. Burman and Bohmont (1961) observed an appreciable reduction in number of pods in beans under water stress conditions. Somewhat similar results were obtained in the present studies.

Analysis of variance for number of pods per plant indicated staftstically significant differences among the three varieties under study during both the years (Table 1). Variety 6601 was the top scorer, having an average number of 23.57 and 23.73 pods per plant for 1971, 72 respectively. As regards various treatments used, all of them showed significant differences. Fifty per cent field capacity produced significantly higher number of pods per plant, values being 25.40 and 25.03 for first and second year respectively. Twenty five per cent of field capacity, the minimum level of soil moisture also produced minimum average number of pods per plant. The values being 15.33 and 15.93 pods per plant for 1971 and 1972, respectively. Variety x treatment interaction was statistically significant for the year 1971, whereas, it was non-significant for the second year of study.

Consistent and appreciable differences for pod production with variety 6601 scoring the top position for both the years, suggest its being under genetic control. Relatively more damaging effect of the lowest level of soil moisture on pod production was brought about by enhanced abscission as the differences for flower production among the varieties were not very sharp. Khan and Ali (1969) and Maurer, *et al.* (1969) also reported similar findings.

Results for number of grains per pod revealed that differences between the varieties were statistically non-significant during both the years of study (Table 2). Variety S-64 was, however, on the top for both the years. Considering the pooled analysis of the various treatments applied, 50 per cent field capacity produced maximum number of 11.05 grains per pod which was significantly higher than remaining two treatments. Lowest value of 4.70 grains per pod was recorded in 25 per cent level of soil moisture. Variety x treatment interaction was significant during both the years of study. Though the differences for number of grains per pod among the three varieties were non-significant, yet the moisture stress levels showed profound impact. The number was reduced to less than half at 25 per cent field capaciey as compared to the optimum level of moisture. Ishii (1969) also noticed identical response exposing mung beans to various regimes of soil moisture.

Data for 100-grain weight presented through table 3, indicate appreciable differences among the three varieties as well as for different treatments of soil moisture. Taking the mean of two years, variety 6601 with a value of 4.718 grams was significantly higher than other two varieties. Among the various treatments applied, 50 per cent field capacity consistently produced heavier grains as compared to other treatments. During both the years, 25 per cent field capacity showed the lowest grain weight, values being 3.051 and 3.059 grams for 1971 and 1972, respectively. Variety x treatment interaction was found to be non-significant during both the years. Considering the overall picture of grain production it may be safely concluded that

TABLE 1. *Number of pods per plant as Affected by various varieties and treatments*

| Varieties | 1971 | | 1972 | | Mean | |
|---|---|---|---|---|---|---|
| | Mean No. of pods/plant | Stat. Sign.* | Mean No. of pods/plant | Stat. Sign.* | Mean No. of pods/plant | Stat. Sign.* |
| 6601 | 23.57 | a | 23.73 | a | 23.65 | a |
| S-64 | 20.40 | b | 20.47 | b | 20.43 | b |
| C-233 | 19.07 | c | 19.30 | b | 19.18 | b |
| S. E. | 0.45 | | 0.51 | | 0.47 | |
| *Treatments* | | | | | | |
| 50% F.C. | 25.40 | a | 25.03 | a | 25.21 | a |
| 37.5% F.C. | 22.30 | b | 22.53 | b | 22.41 | b |
| 25% F.C. | 15.33 | c | 15.93 | c | 15.63 | c |
| S.E. | 0.45 | | 0.51 | | 0.47 | |

TABLE 2. *Number of grains per pod as affected by various varieties & treatments*

| Varieties | 1971 | | 1972 | | Mean | |
|---|---|---|---|---|---|---|
| | Mean No. of seeds/pod | Stat. Sign.* | Mean No. of seeds/pod | Stat. Sign.* | Mean No. of seeds/pod | Stat. Sign.* |
| S-64 | 7.93 | N.S. | 8.70 | N.S. | 8.31 | N.S. |
| 6601 | 7.73 | N.S. | 8.47 | N.S. | 8.10 | N.S. |
| S-233 | 7.57 | N.S. | 8.30 | N.S. | 7.90 | N.S. |
| S.E. | 0.15 | | 0.18 | | 0.16 | |
| *Treatments* | | | | | | |
| 50% F.C. | 11.13 | a | 10.97 | a | 11.5 | a |
| 37.5% C.F. | 8.33 | b | 8.87 | b | 8.60 | b |
| 25> F.C. | 3.77 | c | 5.63 | c | 4.70 | c |
| S.E. | 0.15 | | 0.18 | | 0.16 | |

*Varieties and treatments having the same letter do not differ significantly at the 5 per cent level by Duncan's New multiple Range Test

N.S. = Non.-significant

F.C. = Field capacity.

moisture stress affected grain number more seriously as compared to their weight. Consistently higher mean weight exhibited by variety 6601 is an evidence of its having a relatively better regulation of metabolic processes resulting in better grain filling under conditions of moisture stress.

Timmons, *et al* (1957) and Rawitz and Hillel (1969) obtained substantially reduced grain yield in legumes under progressive stress of soil moisture. Such a reduction was believed to be the consequence of ill effects on yield subscribing characters. Estimates of grain yield summarized through Table 4 revealing statistically significant differences for both years of

TABLE 3. *100-Grain Weight in Groms as Affected by Various Varieties and Treatments*

| Varieties | 1971 | | 1972 | | Mean | |
|---|---|---|---|---|---|---|
| | Mean 100-grain wt. | Stat. Sign.* | Mean 100-grain wt. | Stat. Sign.* | Mean 100 grain wt. | Stat. Sign.* |
| 6601 | 4.723 | a | 5.710 | a | 4.718 | a |
| S-233 | 3.683 | b | 3.695 | b | 3.689 | b |
| S-64 | 3.674 | b | 3.694 | b | 3.684 | b |
| S.E. | 0.099 | | 0.099 | | 0.098 | |
| *Treatments* | | | | | | |
| 50% F.C. | 4.834 | a | 4.843 | a | 4.838 | a |
| 37.5% F-C. | 4.175 | b | 4.201 | b | 4.188 | b |
| 25> F.C. | 3.051 | c | 3.059 | c | 3.055 | c |
| S.E. | 0.099 | | 0.099 | | 0.098 | |

TABLE 4. *Yield per plant in Grams as Affected by Various Varieties and treatments.*

| Varieties | 1971 | | 1972 | | Mean | |
|---|---|---|---|---|---|---|
| | Mean yield in gms/plant | Stat. Sign.* | Mean yield in grams/plant | Stat. Sign.* | Mean yield in grams plant | Stat. Sign.* |
| 6601 | 11.88 | a | 11.78 | a | 11.83 | a |
| S-64 | 8.75 | b | 8.89 | b | 8.82 | b |
| S-233 | 8.51 | b | 8.59 | b | 8.55 | b |
| S.E. | 0.26 | | 0.18 | | 0.17 | |
| *Treatments* | | | | | | |
| 50% F.C. | 11.72 | a | 11.62 | a | 11.68 | a |
| 37.5% F.C. | 10.30 | b | 10.37 | b | 10.33 | b |
| 25% F.C. | 7.12 | c | 7.28 | c | 7.20 | c |
| S.E. | 0.26 | | 0.81 | | 0.17 | |

* — Varieties and treatments having the same letter do not differ significantly at 5 per cent level by Duncan's New multiple Range Test.

F.C. — Field capacity.

[illegible] endorse these findings. In pooled analysis of the years, variety [illegible] scored significantly higher yield of 11.83 grams per plant, whereas, the differences between the other two varieties were statistically non significant. As for the various treatments, highest yield of 11.68 grams per plant was obtained in 50 per cent field capacity. As expected, the minimum value of 7.20 grams was recorded in 25 per cent field capacity. Variety x treatment interaction was significant for the year 1971 only.

From the overall projections of the effects of drought obtained in this study, it is fairly evident that in mung plant, moderate to severe moisture stress exerts relatively more damaging influenee on characters like number of pods per plant, number of grains per pod and 100-grain weight. Since all these characters have profound impact on final productivity, the yield was reduced only as a consequence of the effect of drought on these characters. Such attributes, therefore, deserve particular attention while selecting or breeding varieties of mung for areas inflicted with frequent moisture imbalances.

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