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# EFFECT OF POTASSIUM AND RHIZOBIAL INOCULATION ON GROWTH, YIELD AND QUALITY OF SOYBEAN IN THE SANDY CLAY LOAM SOILS OF KERALA*

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Soybean, a potential source of plant protein and vegetable oil has gained importance in India from 1960. Being a new crop, knowledge on its crop husbandry is rather limited. The requirement of nitrogen and phosphorus by soybean in the clay loam soils of Kerala have been worked out by Nair (1978) and Kurien (1979). With a view to standardise the nutritional requirement of this crop, the present experiment was conducted to study the effect of graded levels of potassium and rhizobial inoculation on growth, yield and quality of soybean.

## Materials and Methods

The experiment was laid out at the Instructional Farm attached to the College of Horticulture, Vellanikkara during the period from June to September 1980. Residual effect of the same experiment was studied during the second crop season (September to November 1980) without disturbing the lay out. The treatments consisted of factorial combinations of five levels of potassium (0, 30, 60, 90 and 120 kg $K_2O$/ha) and two . eve ls of rhizobial inoculation (no inoculation and inoculation). The experiment was laid out in randomised block design with 4 replications. The soil of the experimental area was sandy clay loam with a pH of 4.6. Analysis of the soil indicated that it contained 0.078% total nitrogen, 2.15 ppm available phosphorus and 157.5 ppm available potassium. Soybean variety EC 39821 was used for the study.

All plots received a uniform dose of 20 kg N, 80 kg $P_2O_5$ and 500 kg calcium hydroxide per hectare. Seed treatment was done as per the procedure recommended by the Tamil Nadu Agricultural University. Seeds were dibbled at a spacing of 45 x 5 cm. Protein content of seeds was calculated by multiplying nitrogen content of seeds with the factor 6.25 (Jackson, 1958 and A. 0. A. C., 1950). Oil content of seed was estimated by using soxhlet apparatus (A. 0. C. S., 1971).

## Results and Discussion

### *a) Yield and yield components*

The yield components were not significantly affected by levels of potassium, inoculation and by their interactions during the 1st season. Similarly, the seed yield and stover yield were also not markedly influenced by any of the treatments under study (Table 1).

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The lack of significant effect of potassium on growth characetrs, yield components and seed yield indicates that the native potassium status of the soil was adequate enough forthe satisfactory growth and performance of the plants. It may be noted that the initial soil test data of the experimental field indicate that the soil contained 157.5 ppm of available potassium which is rated as high according to soil test ratings. Similar non-significant effect of applied potassium on seed yield of soybean was reported by Reddi *et al.* (1976). The above results point to the fact that the inherent supply of potassium in the soil can meet the requirement of this crop and hence no potassic fertilizer need be applied to soybean in such soils.

Rhizobiai inoculation also did not influence the various growth and yield characters and seed and stover yield significantly. Such a result shows that the crop did not suffer for want of nitrogen symbiotically fixed. There was also no visual symptom of nitrogen deficiency in the crop. Perhaps the soil would have originally contained adequate number of strains of *Rhizobium japonicum* effective on soybean. Kurien (1979) has observed similar results in the same type of soil consequentto rhizobiai inoculation.

Table 1

Effect of potassium and inoculation on yield and quality characters

| | Seed yield (kg/ha) | | 1st crop season | | | | |
|---|---|---|---|---|---|---|---|
| | 1st crop season | 2nd crop season | Stover yield (kg/ha) | Protein content (%) | Protein yield (kg/ha) | Oil content (%) | Oil yield (kg/ha) |
| *Levels of potassium* ($K_2O$ kg/ha) | | | | | | | |
| 0 | 1941.10 | 362.10 | 2838.50 | 4071 | 791.13 | 19.41 | 376.67 |
| 30 | 2147.75 | 398.48 | 2594.20 | 34.38 | 740.13 | 21.91 | 470.14 |
| 60 | 2251.93 | 375.33 | 2557.90 | 36.52 | 822.88 | 22.70 | 510.15 |
| 90 | 2318.04 | 381.95 | 2523.10 | 35.24 | 816.75 | 21.14 | 490.67 |
| 120 | 2127.93 | 433.20 | 2796.00 | 35.24 | 750.00 | 23.11 | 491.33 |
| SEm+ | 100.26 | 20.21 | 135.78 | 0.237 | 37.00 | 0.154 | 23.277 |
| CD at 5;( | NS | NS | NS | NS | NS | NS | NS |
| *Rhizobiai inoculation* | | | | | | | |
| Uninoculated | 2116.33 | 373.68 | 2640.90 | 35,36 | 747.75 | 22.82 | 483.74 |
| inoculated | 2198.38 | 406.75 | 270300 | 37.47 | 820.60 | 20.49 | 451.95 |
| SEm+ | 63.41 | 13.45 | 85.88 | 0.15 | **23.00** | 0.097 | 15.722 |
| CD at 5% | NS | NS | NS | 0,43 | 68.17 | 0.213 | NS |

Data on protein content of seeds, protein yield, oil content of seeds, and oil yield, are presented in Table 1.

The data revealed that the levels of potassium significantly influenced the protein content of seeds and the control plot recorded the highest protein content of 40.71% which was superior to all other levels. Similar decrease in protein content due to potassium application was reported by Chevalier (1976). Inoculation also influenced the protein content of seeds and the inoculated plot was superior to the uninoculated one. Similar result was reported by Sable and Khuspe (1977). Interaction effect was significant and 0 kg $K_2O$/ha along with inoculation recorded the highest protein content and was superior to all other combinations (Table 2).

Protein yield was not influenced by levels of potassium. This may be due to the non-significant effect of this nutrient on seed yield though it had marked influence on the seed protein content. Inoculation increased the protein yield significantly and highest protein yield of 820.6 kg/ha was recorded in the inoculated treatment against 747.75 kg/ha in the uninoculated one. The significant effect of inoculation on protein content of seeds coupled with the marginal increase in seed yieid due to inoculation might have resulted in recording significantly higher protein yield in the inoculated treatments.

Table 2

Effect of K x inoculation on protein content of seeds at harvest (%)

| Levels of potassium ($K_2O$ kg/ha) | Rhizobial inoculation | | Mean |
|---|---|---|---|
| | Uninoculated | Inoculated | |
| 0 | 38.44 | 42.99 | 40.71 |
| 30 | 32.68 | 36.09 | 34.38 |
| 60 | 36.95 | 36.10 | 36,52 |
| 90 | 34.33 | 36.09 | 35.24 |
| 120 | 34.38 | 36.10 | 35.24 |
| Mean | 36.36 | 37.47 | |
| SEm + 0,335 | CD (0.05) for comparing means of combinations = 0.968 | | |

Table 3

Effect of K x inoculation on oil content of seeds at harvest (%)

| Levels of potassium ($K_2O$ kg/ha) | Rhizobial inoculation | | Mean |
|---|---|---|---|
| | Uninoculated | Inoculated | |
| 0 | 20.31 | 1k.50 | 19.41 |
| 30 | 23.66 | 20.66 | 21.91 |
| 60 | 24.66 | 20.75 | 22.70 |
| 90 | 21 .75 | 20.54 | 21.14 |
| 120 | 24.22 | 22.00 | 23.11 |
| Mean | 22.82 | 20.49 | |
| SEm + 0.218 | CD (0.05) for comparing means of combinations - 0.632 | | |

Levels of potassium had significant effect on the oil content of seeds and the highest oil content of 23.11 % was recorded by 120 kg $K_2O$/ha which was on par with 69 kg $K_2O$/ha, but superior to all other levels. The result obtained in the present investigation is in agreement with the findings of Chevalier (1976). Inoculation negatively influenced the oil content of seeds and the uninoculated treatment was superior to the inoculated one. Similar result was reported by Sable and Khuspe (1977). Interaction effect was significant and 60 kg $K_2O$/ha without inoculation recorded the highest content of 24.66% and was on par with 120 kg $K_2O$/ha without inoculation and superior to all other combinations (Table 3).

There was significant difference in oil yield due to levels of applied potassium and 60 kg $K_2O$/ha recorded the highest oil yield of 510.15 kg/ha and was on par with 120, 93 and 30 kg $K_2O$/ha. Since there was significant difference in oil content due to potassium application, its effect on oil yield was also significant. Similar increase in oil yield due to applied potassium was reported by Chevalier (1978). Inoculation failed to influence the oil yield. Though there was significant variation in oil content of seeds due to inoculation, it could not exert any effect on oil yield. This may be due to the non-significant effect of inoculation on seed yield. Interaction effect was not significant.

*c) Residual effect on yield*

Levels of potassium and inoculation or their interaction did not have any marked influence on seed yield during the second season (Table 1). During the second season a drastic decline in seed yield was also noticed compared to the first season. The total rainfall received during the first season was 2843.57 mm while that during the second season was 272,58 mm only. The crop suffered a lot due to moisture stress during major part of the crop growth including critical stages and as such they could not effectively utilise the nutrients left over by the previous crop and perform better. Doss and Rugeri (1974) reported that yield of soybean was mostly affected by moisture stress during the pod filling period. The non-significant variation in seed yield and the poor performance of the crop noticed in the second season were mainly due to heavy moisture stress than the fertility status of the soil.

## Summary

An experiment wasconducted at the Instructional Farm attached to the College of Horticulture, Vellanikkara to study the effect of potassium and rhizobiai inoculation on growth, yield and quality of soybean. The study revealed that applied potassium and rhizobiai culture inoculation did not significantly influence growth characters, yield components, seed yield and stoveryield. Protein content and oil content were significantly influenced by levels of potassium and inoculation. The highest oil content was recorded by 120 kg $K_2O$/ha and the highest

protein content was obtained without application of potassium. Inoculation increased the protein content and decreased the oil content of seeds. Studies on residual effects of treatments during 2nd crop season revealed that there was no marked variation in seed yield.


## സംഗ്രഹം

ക്ഷാരത്തിനും റൈസോബിയത്തിനും സോയാപയറിന്റെ വളർച്ച, ഉല്പാദനം, ഗുണനിലവാരം എന്നിവയിൽ ചെലുത്താൻ കഴിയുന്ന വ്യതിയാനങ്ങളും കണ്ടുപിടിക്കുന്നതിന് കേരള കാർഷിക സർവകലാശാലയുടെ വെള്ളാനിക്കരയിലുള്ള ഗവേഷണ തോട്ടത്തിൽ നടത്തിയ പരീക്ഷണത്തിൽ നിന്നും ഈ ചെടിയുടെ വളർച്ച, ഉല്പാദനം, gp–ുപാദനത്തിനെ നിയന്ത്രിക്കുന്ന ഘടകങ്ങളും എന്നിവയിൽ ക്ഷാരത്തിനും റൈസോബിയത്തിനും ഗണ്യമായ വ്യതിയാനം വരുത്തുവാൻ സാധിച്ചില്ല എന്നു കണ്ടു. ക്ഷാരത്തിനും റൈസോബിയത്തിനും വിത്തിലെ മാംസ്യം, എണ്ണ എന്നിവയുടെ അളവ് കാര്യമായി വ്യത്യാസപ്പെടുത്തുവാൻ സാധിക്കുമെന്നും ഏറവും കൂടുതൽ മാംസ്യം ലഭിക്കുന്നതിന് ക്ഷാരം ചേർക്കേണ്ടതില്ലെന്നും എന്നാൽ എണ്ണയുടെ അളവ് ഏറവും കൂടുതൽ ലഭിക്കുന്നതിന് ഹെക്ടറിന് 120 കി. ഗ്രാം ക്ഷാരം എന്ന തോതിൽ ചേർക്കണമെന്നും വ്യക്തമായി. വിത്തിൽ റൈസോബിയം പുരട്ടി നടുന്നതുവഴി മാംസ്യത്തിന്റെ അളവ് കൂട്ടാമെന്നും എന്നാൽ അത് എണ്ണയുടെ അളവ് കുറയ്ക്കുമെന്നും കാണപ്പെട്ടു. ക്ഷാരം, റൈസോബിയം എന്നിവയുടെ അവശിഷ്ട വീര്യത്തിന് ഈ ചെടിയുടെ ഉല്പാദനത്തിൽ വ്യതിയാനം വരുത്തുവാൻ സാധിച്ചില്ല.


## References


A. 0. A. C. 1950. *Official Methods of the Association of Agricultural Chemists.* 7th edn, Washington, D. C. 1-343.

A. 0. C. S. 1971. *Official and Tentative Methods of the American Oil Chemists' Society,* Volume 1. 3rd edn, American Oil Chemists' Society, 508 South Sixth Sheet Champaign, Illinois 61820.

Chevalier, H. 1976. Response to potassium fertilizers. Absorption pattern of nutrients of soybean cv. Altona, *Informations Techniques,* 53, 7–15.

Chevalier, H. 1978. The response of soybean to potassium fertilizer. *Fertilizer Use and Production of Carbohydratesand Lipids,* 829–334.

Doss, R. D. and Rugeri, H. T. 1974 Effect of soil water stress at various growth stages on soybean yield. *Agron. J.* 66, 297-299.

Jackson, M. L. 1958 *Soil Chemical Analysis.* Prentice Hall Inc, U. S. A., 111–204.

Kurien, T. M, 1979 Effect of phosphorus nutrition, liming and rhizobial inoculation on soybean *(Glycine max (L.)* Merrill). M Sc. Thesis, Kerala Agricultural University, Vellanikkara, Trichur.

Nair, P. G. 1978 Nitrogen nutrition and rhizobial inoculation on soybean *(Glycine max* (L.) Merrill). M. Sc, Thesis, Kerala Agricultural University, Vellanikkara, Trichur.

Reddi, G. H. S., Rao, Y. Y., Reddi, C. K. and Subbaiah, S. C. 1976 Responss of soybean varieties to potassium under rainfed conditions. *Ann. Arid Zone,* 15, 323–325.

Sable, R. N. and Khuspe, V. S. 1977 Responseof soybean *(Glycine max* (L). *Merril)* var Clark 63 to application of bacterial culture, nitrogen and phosphate fertilization. *J. Man. agric. Univ. 2,* 65–67.

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