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Research Article

# PROTEIN YIELD AND NUTRIENT UPTAKE OF SUMMER GREEN GRAM [*Vigna radiata* L. wilczek] AS INFLUENCED BY SEED PRIMING WITH PLANT GEOMETRY AND NUTRIENT MANAGEMENT

**GOHIL K.O.[1], KUMAR S.[2]* AND JAT A.L.[3]**

[1]Department of Agronomy, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385 506, Gujarat, India
[2]Agroforestry Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385 506, Gujarat, India
[3]Castor-Mustard Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385 506, Gujarat, India
*Corresponding Author: Email-skumarsdau@gmail.com

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**Abstract-** A field experiment was carried out during summer season of 2016 at Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the "effect of seed priming, plant geometry and nutrient management on growth, quality, yield and nutrient acquisition of summer greengram [*Vigna radiata* (L.) Wilczek]". Sixteen treatment combinations consisting of two spacing *viz*., 30 × 10 cm and 30 × 20 cm tested with and without seed priming and four nutrient management *viz*., $N_1$ (100% RDF), $N_2$ (50% RDF through fertilizer + 50% RDF through FYM), $N_3$ (50% RDF through fertilizer + 50% RDF through vermicompost) and $N_4$ (50% RDF through fertilizer + 50% RDF through castor cake) were evaluated in factorial randomized block design with three replications. Greengram was sown at distance of 30 cm × 10 cm with seed priming recorded significantly higher plant height at 30 and 60 DAS, number of seeds/pod, protein yield and seed yield (1035 kg/ha). Nitrogen and phosphorus uptake was also significantly higher under 30 cm × 10 cm planting geometry with seed priming. Among the integrated nutrient management treatment application of 50% RDF through fertilizer + 50% RDF through castor cake recorded significantly higher plant height at 60 DAS, protein content (23.26%), protein yield (231 kg/ha) and seed yield (994 kg/ha) as well as N (54.24 kg/ha) and P (10.83 kg/ha) uptake.

**Key words-** Greengram, Nutrient uptake, Plant geometry, Protein and seed priming.

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## Introduction

Greengram [*Vigna radiata* L. Wilczek] is popularly known as mung bean, belongs to family Fabaceae and is native of India and Central Asia. It is the third important pulse crop cultivated throughout India. Rajasthan, Andhra Pradesh, Maharashtra, Orissa, Uttar Pradesh, Bihar, Punjab, Tamil Nadu, Karnataka, Gujarat are major mungbean producing states. In Gujarat it is mainly grown in the districts of Kachchh, Banaskantha, Mehsana and Panchmahal in *kharif* season. Due to vagaries of monsoon in Gujarat, summer cultivation of greengram is initiated for assured production where irrigation facilities are available. The successful establishment of crop mainly depends upon good quality seed. To provide higher quality of seeds, scientists have developed new technologies called "Seed Enhancement Techniques". The two important enhancement technologies are seed coating and seed priming that have been employed successfully for many crops. Seed priming is a process in which seeds are imbibed either in water or in osmotic solution or combination of solid matrix carrier and water in specific proportion followed by drying before radical emergence. Nutrient management helps in increasing yield and also maintains soil fertility by using inorganic and organic combination. The role of farm yard manure is well recognized as balanced bulky organic manure which supplies macro and micro nutrients essential to plant.

## Material and Methods

The field experiment was conducted during *summer* season of 2016 at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar (24°12' N latitude, 72°12' E longitude and at an altitude of 154.5 m above mean sea level) Gujarat, India. The soil of the experimental field was loamy sand in texture, low in organic carbon (0.17 %) and available nitrogen (161.5 kg/ha), medium in available phosphorus (38.86 kg/ha) and available potash (284.0 kg/ha) with 7.2 soil *p*H. The experiment was laid out in factorial randomized block design with replicated thrice. The experiment was consisted sixteen treatment combinations comprising two spacing with and without seed priming *viz*., $S_1$ (30 × 10 cm without seed priming), $S_2$ (30 × 20 cm without seed priming), $S_3$ (30 × 10 cm with seed priming) and $S_4$ (30 × 20 cm with seed priming) and four integrated nutrient management treatments *viz*., $N_1$ (100% RDF through fertilizer), $N_2$ (50% RDF through fertilizer + 50% RDF through FYM), $N_3$ (50% RDF through fertilizer + 50% RDF through vermicompost) and $N_4$ (50% RDF through fertilizer + 50% RDF through castor cake). The recommended dose of fertilizer for greengram crop was $N_{20}$, $P_{40}$, $K_0$ kg/ha. Organic manures *viz*., FYM, vermicompost and castor cake were applied 15 days before sowing as per treatments. The seeds were treated uniformly with *Rhizobium* and PSB and were dried in the shade before sowing. Greengram variety GM 4 was sown on 12$^{th}$ March using recommended seed rate of 20 kg/ha. The first irrigation was given immediately after sowing and second irrigation was applied three days after sowing for uniform germination and establishment of crop and total 6 irrigations were applied throughout season. Various growth parameters and yield were recorded. The protein content in seed was calculated by multiplying nitrogen content of seed (%) with the conversion factor 6.25. The protein yield (kg/ha) was computed from the data of per cent protein and seed yield (kg/ha) using following formula [1].

$$\text{Protein yield (kg/ha)} = \frac{\text{Protein content (\%)} \times \text{Seed yield (kg/ha)}}{100}$$

The technique employed for the biochemical analysis was Micro Kjeldhal's digestion and distillation method for N estimation and vanodo molybdophosphoric yellow colour method for phosphorus estimation [1]. The standard analysis of variance [2] technique prescribed for randomized block design in factorial concept was performed to compare the treatment means at the 5% level of significance (P=0.05) using least significant difference (LSD).

## Results and Discussion

### Growth and yield

Plant height at 30 and 60 DAS and seed yield (1035 kg/ha) were recorded significantly higher when greengram was sowing with seed priming at a distance of 30 cm × 10 cm planting geometry and it was statistically at par with 30 x 10 cm over remaining treatment [Table-1]. This was due to more number of plants occupied in unit areas under narrow spacing as comparatively to wider spacing crop which could led to produce higher seed yield in unit area. Similar results were obtained by [3]. While, number of seeds/pod was not influenced significantly due to various spacing and nutrient management treatments. Hence, plants were competing to grow more in upward direction for the fulfillment of light requirement for photosynthesis. These results are close conformity with the earlier finding of [4,5]. Significantly higher plant height at 60 DAS (44.1 cm) and seed yield (994 kg/ha) was produced with application of 50% RDF through fertilizer + 50% RDF through castor cake and it was remained statistically at par with 50% RDF + 50% RDF through vermicompost. The increment in yield is attributed due to beneficial effect of optimum and balanced fertilization involving organic and inorganic sources of nutrients have also been investigated by [6,5].

**Table-1** *Effect of plant geometry, seed priming and nutrient management on growth, yield and quality of summer greengram*

| Treatments | Plant height (cm) | | No. of seeds/pod | Seed yield (kg/ha) | Protein content in seed (%) | Protein yield (kg/ha) |
|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | | | | |
| ***Spacing and seed priming*** | | | | | | |
| $S_1$: 30cm × 10cm (without seed priming) | 21.5 | 42.6 | 8.12 | 988 | 22.07 | 219 |
| $S_2$: 30cm × 20cm (without seed priming) | 19.8 | 38.4 | 8.27 | 795 | 22.15 | 177 |
| $S_3$: 30cm × 10cm (with seed priming) | 23.1 | 43.9 | 8.18 | 1035 | 22.03 | 228 |
| $S_4$: 30cm × 20cm (with seed priming) | 21.7 | 39.5 | 8.26 | 848 | 22.28 | 190 |
| SEm± | 0.77 | 1.49 | 0.17 | 29.72 | 0.33 | 7.83 |
| CD (P=0.05) | 2.23 | 4.30 | NS | 85.81 | NS | 22.61 |
| ***Integrated nutrient management*** | | | | | | |
| $N_1$: 100% RDF* by fertilizer | 22.4 | 37.8 | 8.15 | 836 | 20.99 | 175 |
| $N_2$: 50% RDF by fertilizer + 50% RDF by FYM | 20.3 | 39.9 | 8.18 | 897 | 21.80 | 196 |
| $N_3$: 50% RDF by fertilizer + 50% RDF by VC | 21.3 | 42.5 | 8.23 | 939 | 22.47 | 211 |
| $N_4$: 50% RDF by fertilizer + 50% RDF by castor cake | 21.9 | 44.1 | 8.27 | 994 | 23.26 | 231 |
| SEm± | 0.77 | 1.49 | 0.17 | 29.72 | 0.33 | 7.83 |
| CD (P=0.05) | NS | 4.30 | NS | 85.81 | 0.96 | 22.61 |

### Protein content and its yield

The protein content in grain was not influenced significantly due to various spacing and seed priming treatments. However, maximum protein yield (228 kg/ha) was recorded under spacing 30 x 10 cm with seed priming as compared to other treatments except 30 x 10 cm without seed priming which was remained comparatively at par [Table-1]. The increase in protein yield was mainly due to higher seed yield under 30 x 10 cm with seed priming treatment. These results are in accordance with the finding of [7]. Significantly higher protein content (23.26%) and its yield (231 kg/ha) was reported with the application of 50 % RDF through fertilizer + 50% RDF through castor cake but, it was found statistically at par with treatment 50 % RDF through fertilizer + 50% RDF through vermicompost. The supply of nitrogen is related to the protein formation. Further, it is clear that organic manure improved physical, chemical and biological properties of the soil and this led to improved root growth and development and improved water and nutrient uptake resulting into improved seed quality in terms of higher seed protein content. Similar results were also observed by [8].

### Nutrient content and uptake

Nutrient content in grain and stover were not affected significantly due to different planting geometry with and without seed priming [Table-2]. Among the spacing with seed priming, significantly the higher nutrient uptake by crop i.e. 53.63 kg/ha nitrogen and 11.18 kg/ha phosphorus was noted under spacing of 30 x 10 cm with seed priming. However, N uptake by crop was found at par with treatment 30 x 10 cm without seed priming. This was mainly because at closer plant spacing the number of plant population is higher and seed yield and stover yield also higher in closely spaced planting. These results were in conformity with the finding of [9-10]. Application of 50% RDF through fertilizer + 50% RDF through castor cake ($N_4$) recorded significantly the higher nutrient content as well as uptake of nitrogen (54.24 kg/ha) and phosphorus (10.83 kg/ha) by crop. However, P uptake by crop was at par with 50% RDF through fertilizer + 50% RDF through vermicompost. These results are in accordance with [6,8].

**Table-2** *Effect of plant geometry, seed priming and nutrient management on nutrient content, nutrient uptake and soil nutrient status after harvesting of summer greengram*

| Treatments | N content (%) | | P content (%) | | Nutrient uptake (kg/ha) | | Available nutrient in soil after harvest (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Seed | Stover | Seed | Stover | N | P | N | $P_2O_5$ | $K_2O$ |
| ***Spacing and seed priming*** | | | | | | | | | |
| $S_1$: 30cm × 10cm (without seed priming) | 3.53 | 0.73 | 0.55 | 0.22 | 51.40 | 10.45 | 152.91 | 27.44 | 259.84 |
| $S_2$: 30cm × 20cm (without seed priming) | 3.54 | 0.75 | 0.57 | 0.22 | 42.68 | 8.83 | 156.65 | 30.88 | 262.10 |
| $S_3$: 30cm × 10cm (with seed priming) | 3.53 | 0.73 | 0.55 | 0.23 | 53.63 | 11.18 | 150.69 | 27.57 | 260.24 |
| $S_4$: 30cm × 20cm (with seed priming) | 3.57 | 0.76 | 0.56 | 0.23 | 45.14 | 9.16 | 154.10 | 29.35 | 262.52 |
| SEm± | 0.05 | 0.01 | 0.006 | 0.004 | 1.34 | 0.24 | 2.52 | 0.73 | 2.32 |
| CD (P=0.05) | NS | NS | NS | NS | 3.88 | 0.69 | NS | 2.12 | NS |
| ***Integrated nutrient management*** | | | | | | | | | |
| $N_1$: 100% RDF* by fertilizer | 3.36 | 0.75 | 0.56 | 0.26 | 42.62 | 9.19 | 147.00 | 26.82 | 257.25 |
| $N_2$: 50% RDF by fertilizer + 50% RDF by FYM | 3.49 | 0.72 | 0.54 | 0.21 | 46.10 | 9.29 | 159.06 | 31.06 | 260.82 |
| $N_3$: 50% RDF by fertilizer + 50% RDF by VC | 3.60 | 0.74 | 0.56 | 0.23 | 49.89 | 10.31 | 151.89 | 28.35 | 262.90 |
| $N_4$: 50% RDF by fertilizer + 50% RDF by castor cake | 3.72 | 0.77 | 0.57 | 0.25 | 54.24 | 10.83 | 156.39 | 29.01 | 263.73 |
| SEm± | 0.05 | 0.01 | 0.006 | 0.004 | 1.34 | 0.24 | 2.52 | 0.73 | 2.32 |
| CD (P=0.05) | 0.15 | 0.03 | 0.016 | NS | 3.88 | 0.69 | 7.28 | 2.12 | NS |

**Soil fertility status**

The effect of different spacing with and without seed priming was found non-significant on available nitrogen and potassium [Table-2]. While, available phosphorus status in soil after harvest of the crop was found significantly higher when the crop as sown at 30 × 20 cm spacing without seed priming and it was remained at par with 30 x 20 cm spacing with seed priming. Similar results have also been reported by [9]. The application of 50% RDF through fertilizer + 50% RDF through FYM left out significantly higher available nitrogen (159.06 kg/ha) and phosphorus (31.06 kg/ha) which was at par with treatments 50% RDF through fertilizer + 50% RDF through castor cake and also available N was at par with 50% RDF through fertilizer + 50% RDF through vermicompost. However, potassium status was not significantly influenced due to different nutrient treatments but it was marginally higher with application of 50% RDF through fertilizer + 50% RDF through castor cake. This might be due to higher quantity of organic manure was accumulated in soil resulting in buildup of nutrients in the soil under FYM treated plots. Increase in available N, $P_2O_5$ and $K_2O$ might be due to the direct addition through organic manure and greater multiplication of soil microbes, which could convert organically bound into inorganic form. Similar results have also been reported by [5].

**Conclusion:**

Based on the results of one year experiment, it is concluded that good quality seeds with high nutritional value and higher seed yield can be secured by growing greengram (cv. GM 4) at 30 × 10 cm spacing either with or without seed priming along with application of 50 % RDF through fertilizer + 50 % RDF through castor cake in loamy sand soil of North Gujarat.

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**Author Contributions:** All author equally contributed

**Abbreviations:**

LSD : least significant difference

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

**Conflict of Interest: None declared**

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