A field experiment was conducted at Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh during summer, 2016 to study the “Evaluation of spacing and nutrient management in summer greengram (Vigna radiata L. Wilczek)”

This experiment was conducted with two levels of spacing (30 x 10 cm and 45 x 10 cm), three levels of fertilizer (control, 75 % RDF and 100 % RDF) and two levels of bio-fertilizer (no inoculation and inoculation of seed with Rhizobium + PSB) in factorial randomized design replicated three times.

6.1 EFFECT OF SPACING

6.1.1 Various spacing had significant influence of initial and final plant population. Spacing of 30 x 10 cm recorded significantly higher initial and final plant population than 45 x 10 cm spacing.

6.1.2 Various spacing does not influence plant height at 30 DAS but it significantly influence plant height at harvest. Spacing of 30 x 10 cm recorded significantly higher plant height (38.51 cm) than 45 x 10 cm spacing (37.09 cm) at harvest.

6.1.3 Spacing of 45 x 10 cm produced significantly higher number of branches per plant (3.17 and 5.34 at 30 DAS and at harvest, respectively) and dry matter per plant (7.19 g and 14.91 g at 30 DAS and at harvest, respectively) over 30 x 10 cm spacing. While spacing does not exhibit significant influence on days to 50 % flowering.

6.1.4 Spacing of 45 x 10 cm produced significantly higher number of root nodules per plant (10.31 and 16.90 at 45 DAS and at harvest, respectively) and dry weight of root nodules per plant (2.25 g and 3.41 g at 45 DAS and at harvest, respectively) over 30 x 10 cm spacing.

6.1.5 The yield attributing characters viz., numbers of pods per plant, length of pod and test weight were significantly influenced due to various spacing. Higher numbers of pods per plant (26.44), length of pod (6.14 cm) and test weight (38.90 g) were recorded with 45 x 10 cm spacing over 30 x 10 cm
Summary and conclusion

6.1.6 Seed yield of greengram was significantly influenced due to various levels of spacing wherein significantly higher seed yield (930 kg ha\(^{-1}\)) was achieved under 30 x 10 cm spacing whereas 45 x 10 cm spacing recorded significantly the lower seed yield (848 kg ha\(^{-1}\)).

6.1.7 Spacing of 30 x 10 cm gave significantly higher stover yield (2151 kg ha\(^{-1}\)) over 45 x 10 cm spacing which recorded significantly the lower stover yield (1525 kg ha\(^{-1}\)).

6.1.8 Wider spacing of 45 x 10 cm produced significantly the higher protein content (20.92 %) in greengram seed over 30 x 10 cm spacing.

6.1.9 Spacing of 45 x 10 cm significantly improved the content of nitrogen, phosphorus and potassium in seed and stover and uptake of nitrogen and potassium by stover as compared to 30 x 10 cm spacing.

6.1.10 Available nitrogen and phosphorus status in soil after harvest of greengram crop found significantly higher under spacing of 45 x 10 cm as compared to 30 x 10 cm spacing. While spacing does not affect potassium status in soil after harvest of greengram crop.

6.1.11 Spacing of 30 x 10 cm earned the maximum net realization of ₹ 36752 ha\(^{-1}\) with B:C ratio of 3.22. However 45 x 10 cm spacing recorded the minimum values of net realization of ₹ 32038 ha\(^{-1}\) with B:C ratio (2.99).

6.2 EFFECT OF FERTILITY LEVEL

6.2.1 Various levels of fertilizer application did not influence of initial and final plant population.

6.2.2 Various levels of fertilizer application does not influence plant height at 30 DAS. While application of 100 % RDF resulted in significantly highest plant height (38.61 cm) at harvest but it was statistically at par with 75 % RDF (38.58 cm). While, significantly the lowest plant height (36.22 cm) was recorded under control condition.

6.2.3 Application of 100 % RDF produced significantly highest number of branches per plant (2.83) at 30 DAS and dry matter per plant (14.50 g) at harvest but it was statistically at par with 75 % RDF. Application of 75 % RDF produced significantly highest number of branches per plant (5.00) at
Summary and conclusion

harvest and dry matter per plant (6.92 g) at 30 DAS but it was statistically at par with 100 % RDF. Significantly the lowest number of branches per plant and dry matter per plant was recorded under control condition. While fertility levels do not exert significant influence on days to 50 % flowering.

6.2.4 Application of 100 % RDF produced significantly highest number of root nodules per plant (16.85) at harvest and dry weight of root nodules per plant (2.21 g and 3.39 g at 45 DAS and at harvest, respectively) over 30 x 10 cm spacing. While fertility levels do not exert significant influence on number of root nodules per plant at 45 DAS.

6.2.5 The yield attributing characters like number of seeds per pod, length of pod and test weight were significantly influenced due to various fertilizer treatments. Highest number of seeds per pod (7.10), length of pod (6.19 cm) and test weight (39.35 g) were recorded under 100 % RDF treatment but it was statistically at par with 75 % RDF. While fertility levels do not exert significant influence on number of pods per plant.

6.2.6 Seed yield of greengram was significantly influenced due to varying levels of fertilizer wherein significantly highest seed yield (945 kg ha⁻¹) was achieved under treatment 100 % RDF but it was at par with treatment 75 % RDF. Whereas, significantly the lowest seed yield (804 kg ha⁻¹) was recorded with control.

6.2.7 An application of 100 % RDF gave significantly highest stover yield (1900 kg ha⁻¹) but it was at par with treatment 75 % RDF. While control treatment recorded significantly the lowest stover yield (1753 kg ha⁻¹).

6.2.8 Various levels of fertilizer do not significantly affect protein contents in greengram seed.

6.2.9 An application of 100 % RDF significantly improved the uptake of nitrogen by seed and phosphorus by seed and stover as compared to 75 % RDF and control treatment. While fertilizer treatments do not have any significant effect on nutrient content, uptake of nitrogen by stover and uptake of potassium by seed and stover.

6.2.10 Available nitrogen and phosphorus status in soil after harvest of greengram crop found significantly highest under 100 % RDF which was at par with treatment 75 % RDF whereas significantly the lowest nitrogen and phosphorus status in the soil after harvest of the crop was recorded under the
control treatment. While fertilizers does not affect potassium status in soil after harvest of greengram crop.

6.2.11 An application of 100% RDF earned the maximum net realization of ₹36450 ha⁻¹ with B:C ratio of 3.09 followed by 75% RDF. However, control treatment recorded the minimum values of net realization of ₹31148 with B:C ratio (3.10).

6.3 EFFECT OF BIO-FERTILIZER

6.3.1 Various levels of bio-fertilizer application did not exert their significant effect on initial and final plant population.

6.3.2 Various levels of bio-fertilizer application did not exert their significant effect on plant height at 30 DAS and at harvest.

6.3.3 Bio-fertilizer application significantly influence number of branches per plant. Inoculation of seed with *Rhizobium* + PSB gave significantly higher number of branches per plant (2.76 and 4.99 at 30 DAS and at harvest, respectively) over control. While bio-fertilizers does not have significant effect on dry matter accumulation per plant at 30 DAS and at harvesting and days to 50 % flowering.

6.3.4 Inoculation of seed with *Rhizobium* + PSB produced significantly higher number of root nodules per plant (10.07 and 16.62 at 45 DAS and at harvest, respectively) and dry weight of root nodules per plant (2.22 g and 3.36 g at 45 DAS and at harvest, respectively) over control.

6.3.5 The yield attributing characters viz., number of pods per plant, length of pod and test weight are does not have any significantly influenced due to various bio-fertilizer treatments. While number of seeds per pod recorded significantly higher (7.12) with *Rhizobium* + PSB treatment over control.

6.3.6 Seed yield of greengram was not significantly influenced due to various levels of bio- fertilizers.

6.3.7 Inoculation of seed with *Rhizobium* + PSB gave significantly higher stover yield (1909 kg ha⁻¹) over control which recorded significantly the lower stover yield (1768 kg ha⁻¹).

6.3.8 Various levels of bio-fertilizer application did not exert their significant effect on protein content.
Summary and conclusion

6.3.9 An application of *Rhizobium* + PSB significantly improved the uptake of phosphorus by stover as compared to control treatment. While bio-fertilizer treatments do not have any significant effect on nutrient content, uptake of nitrogen and potassium by seed and stover and uptake of phosphorus by seed.

6.3.10 Available nitrogen and phosphorus status in soil after harvest of greengram crop found significantly higher under *Rhizobium* + PSB treatment as compared to control. While, bio-fertilizers does not affect potassium status in soil after harvest of greengram crop.

6.3.11 Inoculation of seed with *Rhizobium* + PSB earned the maximum net realization of ₹ 35621 ha\(^{-1}\) with B:C ratio of 3.17. However, control treatment recorded the minimum values of net realization of ₹ 33169 with B:C ratio (3.04).

6.4 INTERACTION EFFECT

6.4.1 The treatment combination S\(_1\)F\(_1\) (30 x 10 cm spacing with 75 % RDF) recorded significantly higher plant height (40.74 cm) but it was found statistically at par with the treatment combinations S\(_2\)F\(_2\). The lowest plant height (35.48 cm) was recorded with treatment combination S\(_2\)F\(_0\) (45 x 10 cm spacing with no fertilizer).

6.4.2 The treatment combination S\(_2\)F\(_2\) (45 x 10 cm spacing with 100 % RDF) recorded significantly higher number of branches per plant, number of root nodules per plant at 45 DAS and at harvest and dry weight of root nodules per plant at 45 DAS and at harvest. The lowest number of branches per plant, number of root nodules per plant at 45 DAS and at harvest and dry weight of root nodules per plant at 45 DAS and at harvest were recorded with treatment combination S\(_1\)F\(_0\) (30 x 10 cm spacing with no fertilizer).

6.4.3 The treatment combination S\(_1\)B\(_1\) (30 x 10 cm spacing with inoculation of *Rhizobium* + PSB) recorded significantly higher plant height. The lowest plant height was recorded with treatment combination S\(_2\)B\(_1\) (45 x 10 cm spacing with inoculation of *Rhizobium* + PSB).

6.4.4 The treatment combination S\(_2\)B\(_1\) (45 x 10 cm spacing with inoculation of *Rhizobium* + PSB) recorded significantly higher number of root nodules per plant but it was found statistically at par with the treatment combination
Summary and conclusion

The lowest number of root nodules per plant was recorded with treatment combination $S_1B_0$ (30 x 10 cm spacing with no inoculation of bio-fertilizer).

6.4.5 The treatment combination $F_1B_1$ (75 % RDF with inoculation of $Rhizobium$ + PSB) recorded significantly higher plant height, number of root nodules per plant and number of seeds per pod but it was found statistically at par with the treatment combination $F_2B_0$ and $F_0B_1$. The lowest plant height, number of root nodules per plant at harvest, number of seeds per pod were recorded with treatment combination $F_0B_0$ (no fertilizer with no inoculation of bio-fertilizer).

6.4.6 The treatment combination $F_1B_0$ (75 % RDF with no inoculation of bio-fertilizer) and $F_2B_1$ (100 % RDF with $Rhizobium$ + PSB) recorded significantly higher number of branches per plant but it was remain at par with the treatment combinations $F_2B_0$, $F_0B_1$ and $F_1B_1$. The lowest number of branches per plant (4.23) was recorded with treatment combination $F_0B_0$ (no fertilizer with no inoculation of bio-fertilizer).

CONCLUSION

Based on the one year field experimental results, it can be concluded that better crop yield and highest net returns obtained from summer greengram (cv. GM 4) by sowing the crop at 30 x 10 cm spacing and fertilized with 100 % RDF (20-40-00 kg N-P$_2$O$_5$-K$_2$O ha$^{-1}$) in the medium black clayey soil under South Saurashtra Agro-climatic Zone of Gujarat.

Future line of work

The following suggestions are made for future line work on the basis of present findings.

1. Large scale field demonstration should be made for evaluating consistency and applicability of the conclusive recommendation for farmers.
2. The experiment should be conducted at least for three years for consistence result and meaningful conclusion.
3. New varieties of greengram need to be included in the study for better comparison.