Effect of foliar spray and fertilizer levels on growth and yield of vegetable cowpea [Vigna unguiculata (L.) Walp.]

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ABSTRACT
Field experiments were conducted to study the effect of foliar spray and fertilizer levels on growth and yield of vegetable cowpea (PKM 1) during kharif season of the years 2015 and 2016 at Western block, Horticultural College and Research Institute, Periyakulam. Results revealed that in general vegetable cowpea responded well to the increased dose of fertilizers along with foliar spraying of 2 % DAP and pulse wonder during flowering and pod formation stages. Application of 125 % RDF along with 2 % DAP spray at flowering and pod formation stages recorded significantly higher plant height (59.3 cm), more number of branches per plant (10.8), increased root biomass per plant (0.85 g) and shoot biomass per plant (7.8 g) and more number of flowers per plant (58) resulted in increased green pod yield of 17.40 t/ha as compared to 100 % RDF. Lowest yield and economics was recorded with 75 % RDF. Application of 125 % RDF along with 2 % DAP spray at flowering and pod formation stages recorded higher net returns and BC ratio of Rs.117120/- and 3.06 respectively followed by 125 % RDF + Pulse wonder @ 5 kg ha⁻¹ at flowering. The available nutrient status of the post harvest soil sample viz., N (287 kg/ha), P (10.6 kg/ha) and K (217 kg/ha) also increased significantly with the application of 125 % RDF along with 2 % DAP spray at flowering and pod formation stages.

Key words: DAP, Foliar spray, Fertilizer, Pod yield, Pulse wonder.

INTRODUCTION
Pulses play an important role in Indian Agriculture as they restore soil fertility by fixing atmospheric nitrogen through their nodules. These are drought resistant and prevent soil erosion due to their deep root system and good ground coverage. Cowpea [Vigna unguiculata (L.) Walp.] is one of the important kharif pulses grown in India. It is a warm season crop, well adapted to many areas of the humid tropics and sub tropical zones. It is grown throughout India for its long, green vegetable pods, seeds and foliage for fodder. Tender pods used as vegetable and dry beans as pulse. Due to its nutritive value and soil improving properties, it is also used as fodder, green manure and cover crop. Being a legume crop, cowpea fits well in inter-cropping system. The crop is an integral part of sustainable agriculture. 100 g of green tender pods contain 4.3 g of protein, 2.0 fibre, 8.0 g carbohydrates, 74 mg phosphorus, 2.5 mg iron, 13.0 vitamin C, 0.9 mg minerals, etc. In India, vegetable cowpea is cultivated in an area of 0.5 m ha. Though it has high nutritive values and has the potential to cultivate as an intercrop and main crop, the area under cultivation is very low. Vegetable cowpea is indeterminate in flowering and it continues flowering up to the harvest. All the recommended fertilizers are applied as basal and it governs the nutrient requirement for first formed flowers. To obtain genetic yield potential of the crop, the second formed fleshes also have to be nourished. Nutrients play a pivotal role in increasing the seed yield in pulses (Chandrasekhar and Bangarusamy, 2003). Foliar application is credited with the advantage of quick and efficient utilization of nutrients, elimination of losses through leaching and fixation and helps in regulating the uptake of nutrient by plants (Manonmani and Srimathi, 2009). Taking this point in to consideration foliar spraying of 2 % DAP and TNAU Pulse wonder which are recommended for pulses grain production have tried in this experiment along with the reduced and increased level of fertilizer recommendation.

MATERIALS AND METHODS
Field experiments were conducted during consecutive kharif season of the years 2016 and 2017 at Western block of Horticultural College and Research Institute, Periyakulam, Tamil Nadu located at 10.13° N, 77.59° E and at an altitude of 289 m above mean sea level with average rainfall 791.1 mm. The soil was sandy loam having pH 7.1, organic carbon (0.25%), medium in available nitrogen (290 kg/ha), low in available P₂O₅ (10.5 kg/ha) and medium in available potash (215 kg/ha). The field experiment was carried out in randomized block design with three replications. The experiment consists of 12 treatments viz:
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Effect of nutrient management practices on growth parameters of vegetable cowpea PKM 1 (Pooled data of two years).

Vegetable cowpea variety PKM 1 was used for this study. Seeds were sown with the spacing of 45 X 20 cm. 75 %, 100 % and 125 % of recommended dose of fertilizers were calculated and were applied as basal. 2 % DAP solution was prepared and sprayed during flowering and pod formation stages. TNAU Pulse wonder @ 5 kg ha⁻¹ was sprayed during flowering stage. Observations on growth, yield attributes and yield were recorded and analysed statistically. Economics were calculated based on the prevailing market price of the vegetable cowpea and labour wages / man day.

**RESULTS AND DISCUSSION**

**Growth attributes:** Plant height, number of branches per plant, shoot bio mass/plant, root biomass per plant and number of flowers per plant were significantly influenced by fertilizer levels and foliar spraying of pulse wonder and 2 % DAP. Application of 100 % and 125 % recommended dose of fertilizers either alone or in combination with the foliar spray increased all the growth parameters. This was mainly due to the increased nutrient supply and reduced nutrient losses at critical stages of crop growth.

Application of 125 % RDF along with 2 % DAP spray at flowering and pod formation stages recorded increased plant height (59.3 cm), more number of branches per plant (10.8), increased root bio mass per plant (0.85 g) and shoot bio mass per plant (7.8 g) and more number of flowers per plant (58). (Table 1) This might be due to positive response of growth parameters leads to more number of flowers per plant during both the years of study. Due to application of 125 % RDF along with 2 % DAP spray at flowering and pod formation stages, there was a two days advancement of 50 % flowering than the recommended dose of fertilizers. Application of 125 % of RDF along with spraying of 2 per cent DAP helped in quick absorption of nitrogen and phosphorous, at the time of reproductive stage where the nutrient demand is at the peak due to indeterminate growth habit of the crop. Hence, it reduced the flower drop and ultimately enhanced the pod setting. The results are corroborating with the findings of Shashikumar et al. (2013) in blackgram and Choudhary and Yadav (2011) in cowpea.

**Yield attributes and green pod yield:** Application of 125 % RDF along with 2 % DAP spray at flowering and pod formation stages recorded more no.of pods per plant (24) than the rest of the treatments. There was number significant difference between the treatments for other yield attributing characters viz., pod length and pod weight. Pod setting per centage was found to be increased by the foliar application of either 2 % DAP or pulse wonder along with increased dose of fertilizers. This might be due to foliar spray during flowering and pod formation stages supplied required nutrients for enhanced pod setting and reduced the ill filled pods.

**Table 1:** Effect of nutrient management practices on growth parameters of vegetable cowpea PKM 1 (Pooled data of two years).

| Treatments                      | Plant height (cm) | No. of branches/plant | Shoot biomass/Plant(g) | Root biomass/Plant(g) | No. of days to 50% flowering | No. of flowers/plant |
|--------------------------------|-------------------|-----------------------|------------------------|-----------------------|-----------------------------|----------------------|
| T₁  - 75 % RDF                 | 48.3              | 7.1                   | 4.2                    | 0.41                  | 47                          | 30                   |
| T₂  - 100 % RDF                | 50.3              | 8.2                   | 5.2                    | 0.63                  | 47                          | 36                   |
| T₃  - 125 % RDF                | 58.6              | 10.3                  | 7.1                    | 0.84                  | 45                          | 43                   |
| T₄  - 75 % RDF + 2 % DAP spray at flowering | 47.4              | 7.3                   | 4.3                    | 0.43                  | 47                          | 37                   |
| T₅  - 100 % RDF + 2 % DAP spray at flowering | 50.6              | 8.4                   | 5.4                    | 0.65                  | 46                          | 36                   |
| T₆  - 125 % RDF + 2 % DAP spray at flowering | 59.1              | 10.5                  | 7.4                    | 0.83                  | 45                          | 50                   |
| T₇  - 75 % RDF + 2 % DAP spray at flowering and pod formation | 48.5              | 7.8                   | 4.9                    | 0.48                  | 47                          | 38                   |
| T₈  - 100 % RDF + 2 % DAP spray at flowering and pod formation | 50.8              | 8.6                   | 6.1                    | 0.68                  | 47                          | 45                   |
| T₉  - 125 % RDF + 2 % DAP spray at flowering and pod formation | 59.3              | 10.8                  | 7.8                    | 0.85                  | 46                          | 58                   |
| T₁₀ - 75 % RDF + Pulse wonder @ 5 kg ha⁻¹ | 48.8              | 7.5                   | 4.5                    | 0.45                  | 48                          | 39                   |
| T₁₁ - 100 % RDF + Pulse wonder @ 5 kg ha⁻¹ | 50.4              | 8.8                   | 5.9                    | 0.71                  | 46                          | 44                   |
| T₁₂ - 125 % RDF + Pulse wonder @ 5 kg ha⁻¹ | 58.8              | 10.5                  | 7.5                    | 0.89                  | 46.0                        | 52                   |
| SEd                            | 2.54              | 0.43                  | 0.29                   | 0.03                  | 2.26                        | NS                   |
| CD (P= 0.05)                   | 5.27              | 0.89                  | 0.60                   | 0.07                  | NS                          |                      |
Table 2: Effect of nutrient management practices on yield parameters and green pod yield of vegetable cowpea PKM 1 (Pooled data of two years).

| Treatments | No. of Pods/plant | Pod setting (%) | Pod length (cm) | Pod weight (g/pod) | Pod Yield (g/plant) | Pod yield (t/ha) |
|------------|--------------------|-----------------|-----------------|-------------------|--------------------|-----------------|
| T<sub>1</sub> 75 % RDF | 12 | 40 | 21.1 | 11.4 | 137 | 7.65 |
| T<sub>2</sub> 100 % RDF | 15 | 42 | 21.7 | 11.7 | 176 | 10.54 |
| T<sub>3</sub> 125 % RDF | 19 | 44 | 22.6 | 12.4 | 236 | 14.98 |
| T<sub>4</sub> 75 % RDF + 2 % DAP spray at flowering | 12 | 32 | 21.3 | 12.0 | 144 | 8.17 |
| T<sub>5</sub> 100 % RDF + 2 % DAP spray at flowering | 16 | 37 | 22.1 | 12.3 | 197 | 12.09 |
| T<sub>6</sub> 125 % RDF + 2 % DAP spray at flowering | 20 | 40 | 22.7 | 12.6 | 252 | 16.17 |
| T<sub>7</sub> 125 % RDF + 2 % DAP spray at flowering and pod formation | 13 | 34 | 21.4 | 12.1 | 159 | 9.28 |
| T<sub>8</sub> 75 % RDF + 2 % DAP spray at flowering | 12 | 34 | 21.4 | 12.1 | 159 | 9.28 |
| T<sub>9</sub> 100 % RDF + 2 % DAP spray at flowering | 17 | 38 | 22.2 | 12.3 | 209 | 12.98 |
| T<sub>10</sub> 125 % RDF + 2 % DAP spray at flowering | 24 | 41 | 23.0 | 12.8 | 307 | 17.40 |
| T<sub>11</sub> 75 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 13 | 31 | 21.4 | 12.1 | 152 | 8.76 |
| T<sub>12</sub> 100 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 16 | 36 | 22.1 | 12.4 | 198 | 12.17 |
| T<sub>13</sub> 125 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 20 | 38 | 23.0 | 12.7 | 254 | 16.31 |

SED 1.07 0.59 9.93 0.60

CD (P= 0.05) NS NS 20.6 1.26

Table 3: Effect of nutrient management practices on available N, P and K (kg/ha) in post harvest soil sample.

| Treatments | N | P | K |
|------------|---|---|---|
| T<sub>1</sub> 75 % RDF | 248 | 8.4 | 178 |
| T<sub>2</sub> 100 % RDF | 268 | 9.4 | 191 |
| T<sub>3</sub> 125 % RDF | 281 | 10.3 | 213 |
| T<sub>4</sub> 75 % RDF + 2 % DAP spray at flowering | 256 | 8.7 | 181 |
| T<sub>5</sub> 100 % RDF + 2 % DAP spray at flowering | 270 | 9.3 | 194 |
| T<sub>6</sub> 125 % RDF + 2 % DAP spray at flowering | 285 | 10.1 | 215 |
| T<sub>7</sub> 75 % RDF + 2 % DAP spray at flowering and pod formation | 248 | 8.4 | 187 |
| T<sub>8</sub> 100 % RDF + 2 % DAP spray at flowering and pod formation | 275 | 9.4 | 193 |
| T<sub>9</sub> 125 % RDF + 2 % DAP spray at flowering and pod formation | 287 | 10.6 | 217 |
| T<sub>10</sub> 75 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 245 | 8.4 | 182 |
| T<sub>11</sub> 100 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 272 | 9.1 | 191 |
| T<sub>12</sub> 125 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 290 | 10.1 | 220 |

SED 13.1 0.45 9.6

CD (P= 0.05) 27.1 0.93 19.9

Table 4: Effect of nutrient management practices on green pod yield and economics of vegetable cowpea PKM 1 (Pooled data of two years).

| Treatments | Pod yield (t/ha) | Gross return (Rs./ha) | cost of cultivation (Rs./ha) | Net return (Rs./ha) | B:C ratio |
|------------|-----------------|-----------------------|-----------------------------|-------------------|-----------|
| T<sub>1</sub> 75 % RDF | 7.65 | 76481 | 53486 | 22995 | 1.43 |
| T<sub>2</sub> 100 % RDF | 10.54 | 105370 | 54448 | 50922 | 1.94 |
| T<sub>3</sub> 125 % RDF | 14.98 | 149815 | 55380 | 94435 | 2.71 |
| T<sub>4</sub> 75 % RDF + 2 % DAP spray at flowering | 8.17 | 81667 | 54236 | 27431 | 1.51 |
| T<sub>5</sub> 100 % RDF + 2 % DAP spray at flowering | 12.09 | 120926 | 55198 | 65728 | 2.19 |
| T<sub>6</sub> 125 % RDF + 2 % DAP spray at flowering | 16.17 | 161667 | 56130 | 105536 | 2.88 |
| T<sub>7</sub> 75 % RDF + 2 % DAP spray at flowering and pod formation | 9.28 | 92778 | 54986 | 37792 | 1.69 |
| T<sub>8</sub> 100 % RDF + 2 % DAP spray at flowering and pod formation | 12.98 | 129815 | 55948 | 73867 | 2.32 |
| T<sub>9</sub> 125 % RDF + 2 % DAP spray at flowering and pod formation | 17.40 | 174000 | 56880 | 117120 | 3.06 |
| T<sub>10</sub> 75 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 8.76 | 87592 | 54486 | 33106 | 1.61 |
| T<sub>11</sub> 100 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 12.17 | 121667 | 55448 | 66219 | 2.19 |
| T<sub>12</sub> 125 % RDF + Pulse wonder @ 5 kg ha<sup>1</sup> at flowering | 16.31 | 163148 | 56380 | 106768 | 2.89 |

SED 0.60 - - -

CD (P= 0.05) 1.26 - - -
Application of 125% RDF along with 2% DAP spray at flowering and pod formation stages recorded increased green pod yield of 17.40 t/ha. This was followed by application of 125% RDF along with TNAU pulse wonder @5 kg/ha at flowering stage. (Table 2). The above result clearly indicates the importance of inorganic foliar nutrition in determination of yield potential in vegetable cowpea. The increased pod yield due to beneficial effect of nutrients applied at proper time and stage was also reported by Barik and Rout (1990), Yakadri and Thatikunta (2002) in blackgram and Parasuraman et al. (2001) in cowpea, where foliar application of nutrients at flowering and pod development stage might have been easily absorbed and better translocated in the plant and maintained constant requirement of N and P at the reproductive stage of the crop.

Available nutrient status and economics: The available nutrient status of the post harvest soil sample viz., N (287 kg/ha), P (10.6 kg/ha) and K (217 kg/ha) also increased significantly with the above treatment due to higher dose of fertilizer application than the rest of the treatments. (Table 3).

Application of 125% RDF along with 2% DAP spray at flowering and pod formation stages recorded higher net returns and BC ratio of Rs.117120/- and 3.06 respectively (Table 4). Though the cost of cultivation was more than the other treatments due to application of 2% DAP, increased green pod yield was recorded and there by increased net returns and BC ratio were obtained.

CONCLUSION

To nourish the second flush flowers and for better pod setting percentage in Vegetable cowpea along with the increased dose of fertilizers foliar spraying of 2% DAP and TNAU pulse wonder @5 kg/ha were tried at flowering and pod formation stages. All the growth and yield attributes were significantly influenced by the application of increased dose of fertilizers. Basal application of 125% RDF along with 2% DAP spray at flowering and pod formation stages recorded increased plant height, number of branches per plant, root bio mass per plant and shoot bio mass per plant and more number of flowers per plant, green pod yield and there by increased economic returns and benefit cost ratio. Hence, application of 125% RDF along with 2% DAP spray at flowering and pod formation stages is recommended to the vegetable growing farmers for getting higher green pod yield and economic returns in vegetable cowpea.

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