Journal of Advances in Biology & Biotechnology

22(4): 1-9, 2019; Article no.JABB.53342
ISSN: 2394-1081

Influence of Foliar Nutrition on Seed Setting Percentage, Yield and Economics of Red Gram (*Cajanus cajan* (L.) under Irrigated Condition

C. Sivakumar[1*], Krishnaveni[2] and M. Pandiyan[3]

[1]Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Vazhavachanur-606 753, Thiruvannamalai District, Tamil Nadu, India.
[2]Department of Environmental Sciences, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Vazhavachanur-606 753, Thiruvannamalai District, Tamil Nadu, India.
[3]Agricultural College and Research Institute, Tamil Nadu Agricultural University, Vazhavachanur-606 753, Thiruvannamalai District, Tamil Nadu, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JABB/2019/v22i430125
Editor(s):
(1) Dr. Preeya Puangsomlee Wangsomnuk, Department of Biology, Khon Kaen University, Khon Kaen, Thailand.
(2) Dr. Maria Serrano, Department of Applied Biology, EPSO, University Miguel Hernandez, Orihuela, Alicante, Spain.
Reviewers:
(1) Esraa Ashraf Ahmed El Hawary, Ain Shams University, Egypt.
(2) Yesim Togay, Mugla S. K. University, Turkey.
(3) Vijaysingh Thakur, University of Agricultural Sciences, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/53342

Original Research Article

Received 25 October 2019
Accepted 28 December 2019
Published 01 January 2020

ABSTRACT

Field experiments were conducted to study the influence of foliar nutrition on pod setting percentage, yield and economics of red gram (*Cajanus cajan (L.)* under the irrigated condition at Regional Research Station, Tamil Nadu Agricultural University, Paiyur - 635 112, Tamil Nadu, India in Kharif season of 2016-17. To study the effect of different nutrient sources the following treatments were imposed. The treatments include the foliar application of 2% DAP twice at flowering and 15 days thereafter first spray (T_1), Foliar application of TNAU pulse wonder at 5 kg/ha at peak flowering (T_2), Foliar application of 0.5% MAP twice at flowering and 15 days thereafter first spray (T_3). Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter (T_4) and Control (water spray)(T_5). Among the treatments, it was concluded that application of 0.5% mono ammonium phosphate (MAP) at flowering and 15 days after the first spray recorded the higher grain and stalk yield of 1522 and 6222 kg ha-^{1} in red gram respectively and also recorded a higher gross income of

**Corresponding author: E-mail: sivachi15@yahoo.co.in;*

Rs. 91320, net income of Rs. 50520 and B: C ratio of 2.2. Further, the yield increase was 25% higher yield over control (water spray) and 12% higher over-application of CCC 200 ppm twice at flowering and 15 days after the first spray.

Keywords: Red gram; foliar spray; monoammonium phosphate; diammonium phosphate; Cycocel (CCC); pulse wonder grain yield; economics.

1. INTRODUCTION

Pigeonpea (*Cajanus cajan* (L.)) is one of the essential and protein-rich legume crops of the tropical and subtropical countries. The crops have multipurpose value with exceptional characteristics. It finds an essential position in the cropping system followed by a small farmer in the rainfed zone of developing countries. India occupies 90 per cent of the area and production of the world, which is grown in an area of 3.53 m ha with an annual production of 2.51 million tones with the productivity of 711 kg ha^{-1}. It is mainly grown in states of Maharashtra, Uttar Pradesh, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu and these states constitute 90 per cent of the area in India. To increase the pulses production, as should have to extend the area by horizontal expansion is not possible but the vertical expansion of the production is possible by adopting recent technologies. Foliar nutrition is one of the methods to increases pulses production. In this line, it is tried to increase production by adopting different water-soluble fertilizers. Most of the plant nutrients are absorbed through the leaves and absorption would be remarkably rapid and nearly complete the foliar application of superphosphate and DAP was found beneficial than soil application in crops due to fixation as insoluble forms in the soil as triphosphates [1]. Presently, 2% DAP is recommended for foliar spraying in pulses to prevent flower drop and better seed set. At present, in spite of several demonstrations on the effect of 2% DAP spray boosted yield in red gram, farmers are failing to adopt for the following reasons. Dissolving of DAP is time-consuming, filtering of supernatants is requiring skills. It is not compatible with plant protection chemicals. During spray, sometimes it causes severe phytotoxicity effects due to accumulation of solid form at the time of spraying as it settles after some time. Hence the study has been conducted on different phosphorus sources.

1.1 Importance of Foliar Nutrition in Pulse

The plants are absorbing the nutrients especially through the root and translocated to different parts of the plant through xylem vessels. But, the leaves absorption will be rapid and useful in early maturing crops. The foliar nutrition is applied to any type of crops and another advantage is that it reduces the cost of cultivation which in turn reduces the amount of fertilizer thereby reducing the cost of crop production. Foliar application of nitrogen-based fertilizer at the critical stage of the crop rectify the slow growth, nodule senescence and low seed yield of pulse without involving root absorption [2]. Latha and Nadanassababady, Manivannan et al. [3] found that seed treatment with *Rhizobium* and foliar application of micro sol, NPK and Cheated micronutrients recorded maximum higher leaf area index, dry matter production and crop growth rate. Foliar application of nutrients at appropriate stages of crop growth is very important for its effective utilization and performance of the crop [4]. Another finding was that the combined spraying of 0.5 per cent FeSo4 and 0.5 per cent ZnSo4 at 45 days after sowing shown the effectiveness and increased the seed yield by 43.1 per cent when compared to control [5]. Bhowmick et al. [6] stated that there was no tillage operation was done as a relay crop for sowing pulses and difficult to apply fertilizer as basal placement or top dressing. Foliar application of nutrient and growth regulator at pre-flowering and the flowering stage was the reduction in flower dropping percentage in green gram [7]. Foliar application of NAA at 40 ppm at the pre-flowering stage in Blackgram influenced growth characteristics by showing increased plant height, the number of branches and higher Leaf Area Index [8]. Therefore, the scope of fertilization becomes confined to foliar nutrition in rabi pulses. Foliar application of biogas slurry with nutrient containing panchagavya spray has increased the grain yield in green gram [9].

1.2 Effect of Foliar Application on Plant Height, Yield Components and Yield of Red Gram

The plant height is one of the important biometric parameter influenced by the applied nutrient sources, bio-inputs and growth regulators. Application of boron and molybdenum as the foliar spray has significantly improved the plant height in Bengal gram [10]. Pandian et al. [11]

stated that the application of a basal dose of fertilizer combined with 2 per cent DAP (Diammonium phosphate) spray twice had registered higher plant height (73.5 cm) and net return in green gram. Srivastava and Srivastava [12] stated the foliar spray of 2 per cent DAP twice with the recommended dose of fertilizer registered the maximum plant height of chickpea. Ramesh and Thirumurugan [13] stated that foliar applications of 2 per cent DAP and 1 per cent KCL along with benzyl adenine 25 ppm had significantly increased the plant height in soybean.

Foliar application of 2 per cent urea in mungbean at pre-bloom stage registered the higher number of flowers [14]. Annadurai and Planiappan [15] reported that foliar spraying of 25, 50, 75, 100, 125 or 150 ppm salicylic acid on 12, 24 or 36 DAS increased the number of flowers plant-1 in soybean. Foliar spray of 3 per cent DAP spray at flowering and followed by fortnight later significantly increased the number of pods plant-1, 100-grain weight and ultimately grain yield in black gram and green gram [16].

Foliar application of DAP at overdose cause reduced the seed yield once or twice because of the scorching effect in gram [17]. To overcome the problems of 2% DAP to boost in yield of red gram, the present investigation will be carried out to study the effect of MAP on foliar nutrition as it is a highly water-soluble fertilizer and having compatibility with plant protection chemicals. In red gram, pod setting is most important for getting higher yield to reduce flower drop and seed set percentage. Conversion of energy from source to sink need Phosphorous. In this context, plants can not able to uptake nutrient from the soil as it is fixed in the soil and foliar application of Mono Ammonium phosphate supply the nutrients.

In red gram, pod setting is most important for getting higher yield to reduce flower drop and seed set percentage. Conversion of energy from source to sink needs Phosphorus. In this context, plants can not able to uptake nutrient from the soil as it is fixed in the soil and foliar application of Mono Ammonium phosphate supply the nutrients.

2. MATERIALS AND METHODS

Field experiments were conducted to study the influence of foliar nutrition on yield and economics of red gram (*Cajanus cajan (L.)* under irrigated condition at Regional Research Station, Tamil Nadu Agricultural University, Paiyur - 635 112, Tamil Nadu, India in Kharif of 2016-17 in randomized block design with five treatments with four replications in red gram variety Co (Rg) 7 were done with a spacing of 60 x 30 cm. The characteristics of the variety follow.

2.1 Treatment Details

T_1 - Foliar application of 2% DAP twice at flowering and 15 days thereafter first spray

T_2 - Foliar application of TNAU pulse wonder at 5 kg/ha at peak flowering

T_3 - Foliar application of 0.5% MAP twice at flowering and 15 days thereafter first spray

T_4 - Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter

T_5 – Control

Table 1. Characteristics of the variety

Particulars	Co (Rg) 7
Year of Release	2004
Year of Notification	SO.1177(E)/25.08.2005
Parentage	Selection from PB 9825
50% flowering(days)	70-90
Duration (days)	120-130
Grain yield Rainfed (kg/ha)	950
Grain yield Irrigated (kg/ha)	1168
Plant height (cm)	120-130
Branches	7-9
Plant spread	Semi spreading
Colour of standard petal	Yellow with light red vein at the base
Colour of pods	Green with purple streaks
Colour of grain	Reddish-brown
100-grain wt (g)	8.5-11.0
Pattern of growth	Indeterminate

The recommended dose of NPK (25:50:25 kg ha^{-1}) was applied as basal and top dressing during earthing up operation at the time of sowing based on the initial soil test value. The soil was sandy loam in texture with pH 8.1. The available nitrogen, phosphorus and potassium content were 175, 25 and 235 kg/ha with organic carbon of 0.5. per cent The variety used was CO (Rg) 7. Pre-emergence application of pendimethalin @ 0.75 kg ha^{-1} applied 3rd DAS followed by postemergence herbicide imazethapyr @ 100 g/ha was applied on 10-15 DAE of weeds + HW on 50 DAS. The observation on plant height was recorded in the frequent interval at 30, 60, 90 and 120 DAS. Root length and the number of branches were recorded. As per the treatment schedule, 2% DAP, 0.5% MAP and 200 ppm CCC were applied on 60 DAS at flower initiation period followed by 1% pulse wonder was applied at peak flowering stage at 70 DAS. For control of flower Webber, Indoxacarp @ 2 ml/lit with wetting agent 1 ml/lit was applied as a plant protection measures.

Growth characters like Plant height (cm) was measured at 30, 60, 90 and 120 DAS, no of branches plant-1 measured at peak flowering stage (90 DAS) and Root length (cm) was measured during the seedling stage.

The yield attributes like no. of pods $plant^{-1}$ no. of seeds pod^{-1} and pod setting (%) were calculated.

$$\text{Pod setting (\%)} = \frac{\text{No of pods /plant}}{\text{No. of flowers/plant}} \times 100$$

3. RESULTS AND DISCUSSION

To increase the productivity of red gram, adopted different foliar nutrient treatment combinations. From this research, the foliar nutrition of Diammonium phosphate (DAP), Monoammonium phosphate (MAP), pulse wonder and cycocel were sprayed. The results are presented here and discussion was made based on the results obtained from the results research.

3.1 Growth Characters

Plant height is one of the significant growth parameters, which was inclined by the foliar application of nutrients at the right time. The results of the experiments indicated in Table 2. Plant height was recorded at 30, 60, 90 and 120 DAS. There was no significant variation in plant height among the treatments up to 120 DAS.

Among the different foliar spray, that the application of 0.5% mono ammonium phosphate (MAP) at flowering and 15 days thereafter recorded higher plant height of 50.2,142. 2,154.38 cm and 162.0 at 30, 60, 90 and 120 DAS, respectively, and it was recorded a higher number of branches per plant and root length of 8.6 and 34.4 cm, respectively. Control (water spray) (T_1) recorded a shorter plant height of 120.2 and 129.1 cm at 90 and 120 DAS, respectively. Regarding the number of branches, spraying of 0.5% Mono Ammonium Phosphate (MAP) on flowering & 15 days after first spray (T_3) recorded a higher number of branches per plant and root length of 8.6 and 34.4 cm, respectively. The similar results are obtained by using foliar spray [18] in green gram, Srivastava and Srivastava [19] in chickpea and soybean Ramesh and Thirumurugan [20].

3.2 Yield Parameters and Yield

Among the different foliar spray, application of 0.5% mono ammonium phosphate (MAP) on flowering & 15 days after the first spray recorded higher pod setting percentage, and number of pods $plant^{-1}$, number of seeds pod^{-1} and 100 seed weight of 32, 126, 4.7 and 11.3 respectively (Table 3). Pod setting is higher where the treatment having spray with 0.5% of MAP as MAP is easily soluble in water as compared with fertilizers.MAP contains 61% of the phosphorous and it helps energy conversion from source to sink. It also helps for flower drop from the red gram.

Similarly, Kandagal et al. [21] reported that application of 2 per cent urea at the pre-bloom stage in mungbean recorded a significantly higher number of flowers. Annadurai and Palaniappan 1994 reported that foliar spraying of 2% DAP at boot leaf stage and 50 per cent flowering and post- milk stages increased all the yield attributes in rice. Foliar application of one per cent DAP + 0.5 per cent urea recorded significantly a greater number of pods plant per plant in irrigated black gram Subramani et al. 2002 [22] and Anadhakrishnaveni, [23] in green gram.

3.3 Yield and Economics

Application of 0.5% mono ammonium phosphate (MAP) on flowering and 15 days after the first spray recorded higher grain and stalk yield of 1522 and 6222 kg ha^{-1} (Table 4) and it was recorded higher harvest index of 0.2. The economics was worked out for all treatments.

Regarding economics, application of 0.5% mono ammonium phosphate (MAP) on flowering and 15 days after the first spray (T_3) recorded higher net income of Rs.50720/- and B:C ratio 2.20. The higher yield of red gram is due to energy conversion from source and sink. It also increases the pod setting percentage and finally boosts the seed yield. Solaiappan and Ramiah [24] observed similar results in a foliar spray of three per cent DAP. A similar result was observed by Jayarani Reddy [25] and Ganapathy et al. [26]. However, research on MAP is very much limited in a foliar spray. Now, it is gaining momentum to spray MAP as alternate to DAP. Mono Ammonium Phosphate (MAP) contains 12% N and 61% P_2O_5. It is a fully water-soluble fertilizer, a highly efficient source of phosphorus and nitrogen for plants. MAP can serve as a high-quality source of phosphorus during different stages of the growth cycle. Vinothkumar et al. [27] observed that foliar application of 2% DAP increased the yield parameters and yield.

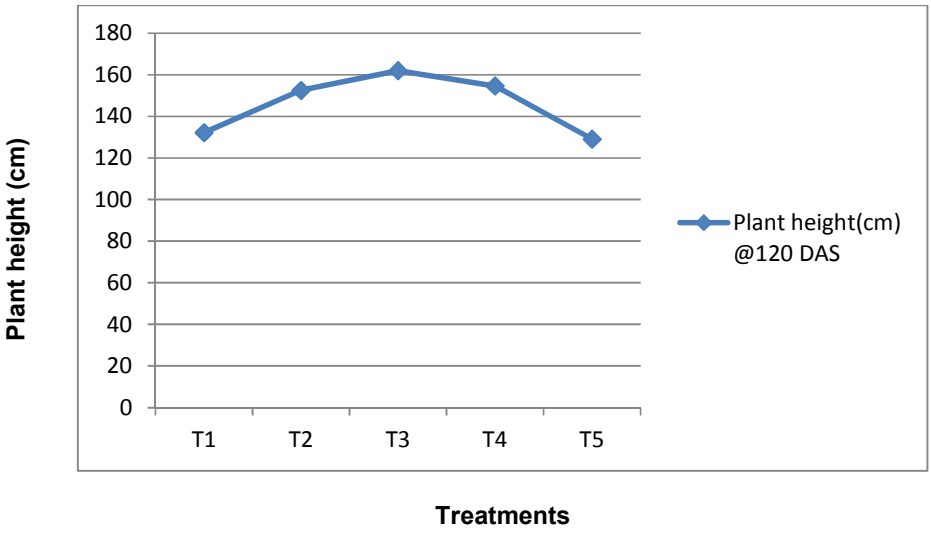

Fig. 1. Effect of different foliar spraying on plant height (cm) parameters of a red gram at 90 DAS

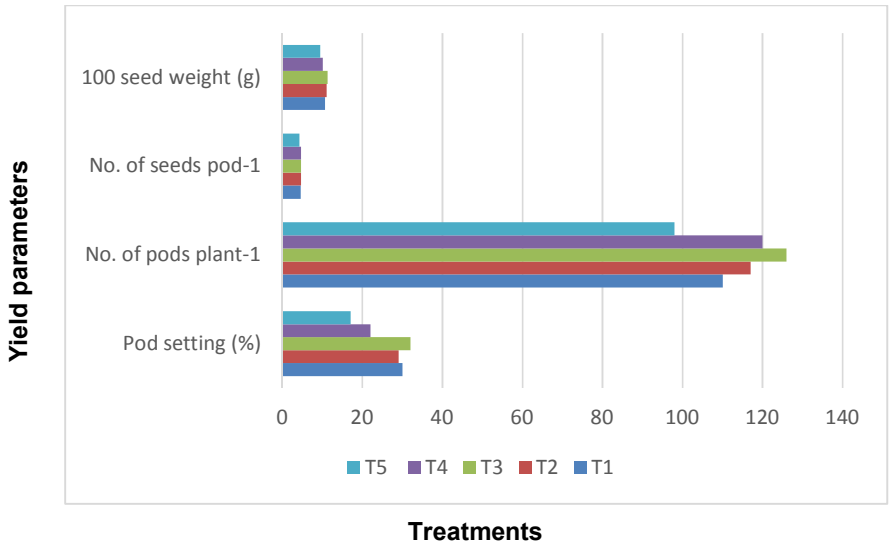

Fig. 2. Effect of different foliar spraying treatments on yield parameters of red gram

T_1 - Foliar application of 2% DAP twice at flowering and 15 days thereafter, T_2 - Foliar application of TNAU Pulse wonder @ 5 kg ha-^{1} at peak flowering stage, T_3- Foliar application of 0.5% MAP twice at flowering and 15 days thereafter, T_4 - Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter, $T_{5\text{ - Control}}$ (water spray)

Table 2. Effect of different foliar spraying treatments on growth parameters of red gram

Treatments	Plant height(cm)				No of branches plant^{-1}	Root length (cm)
	30 DAS	60 DAS	90 DAS	120 DAS		
T_1 - Foliar application of 2% DAP twice at flowering and 15 days thereafter	49.7	127.9	131.9	132.2	7.6	29.3
T_2 - Foliar application of TNAU Pulse wonder @ 5 kg ha^{-1} at peak flowering stage	48.8	135.1	145.1	152.5	6.6	28.2
T_3- Foliar application of 0.5% MAP twice at flowering and 15 days thereafter	50.2	142.2	154.3	162.0	8.6	34.4
T_4 - Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter	52.3	136.6	144.3	154.6	7.6	29.2
T_5 - Control (water spray)	37.6	72.5	120.2	129.1	5.9	19.5
SEd	3.9	4.1	3.8	6.7	1.3	2.5
CD(p=0.05)	NS	NS	NS	NS	2.7	5.3

Table 3. Effect of different foliar spraying treatments on yield parameters of red gram

Treatments	Pod setting (%)	No. of pods plant^{-1}	No. of seeds pod^{-1}	100 seed weight (g)
T_1 - Foliar application of 2% DAP twice at flowering and 15 days thereafter	30	110	4.6	10.6
T_2 - Foliar application of TNAU Pulse wonder @ 5 kg ha^{-1} at peak flowering stage	29	117	4.7	11.0
T_3- Foliar application of 0.5% MAP twice at flowering and 15 days thereafter	32	126	4.7	11.3
T_4 - Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter	22	120	4.7	10.1
T_5 - Control (water spray)	17	98	4.2	9.4
SEd	3.7	18.8	1.05	1.5
CD(p=0.05)	7.1	35.8	2.1	2.7

Table 4. Effect of different foliar spraying treatments on yield and economics of red gram

Treatments	Grain yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Harvest index	Gross income (ha^{-1}) (Rs)	Cost of cultivation (ha^{-1}) (Rs)	Net income (ha^{-1}) (Rs)	B:C ratio
T_1 - Foliar application of 2% DAP twice at flowering and 15 days thereafter	1166	5222	0.18	69960	40650	29310	1.70
T_2 - Foliar application of TNAU Pulse wonder @ 5 kg ha^{-1} at peak flowering stage	1277	5799	0.18	76620	39950	36670	2.00
T_3- Foliar application of 0.5% MAP twice at flowering and 15 days thereafter	1522	6222	0.20	91320	40600	50720	2.20
T_4 - Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter	1333	5999	0.18	79980	40120	39860	2.00
T_5 - Control (water spray)	1122	5377	0.15	61710	39000	22710	1.52
SEd	115	310	-	-	-	-	-
CD(p=0.05)	217	615	-	-	-	-	-

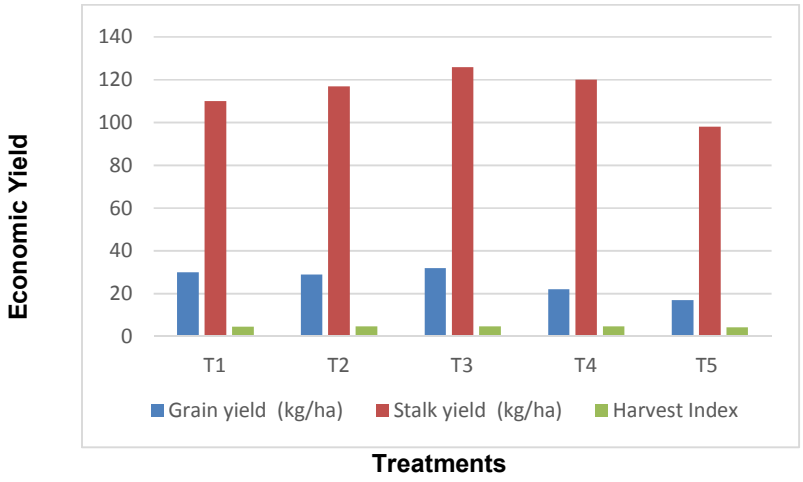

Fig. 3. Effect of different foliar spraying treatments on the yield of red gram

T_1 - Foliar application of 2% DAP twice at flowering and 15 days thereafter, T_2 - Foliar application of TNAU Pulse wonder @ 5 kg ha-^{1} at peak flowering stage, T_3- Foliar application of 0.5% MAP twice at flowering and 15 days thereafter, T_4 - Foliar application of CCC 200 ppm twice at flowering and 15 days thereafter, $T_{5\text{ - Control}}$ (water spray)

Its high purity and water-solubility make MAP an ideal fertilizer for fertigation and foliar application. Not only that MAP is an efficient source of phosphorus, but it also facilitates plant uptake of the phosphorus naturally present in the soil. This is due to the ammonium (NH4 +) in MAP, which lowers the pH in the root zone and thus enhances phosphorus availability. On young leaves, spray concentration of 0.5% MAP is recommended in most crops. Control (Water spray) recorded lower grain and stalk yield of 1122 and 5337 kg ha-^{1} (Table 4) and it was recorded lower harvest index of 0.15. It recorded lower net income of Rs. 22710/- and B:C ratio 1.52 in Control (water spray).

4. CONCLUSION

At present, in spite of several demonstrations on the effect of 2% DAP spray boosted yield in red gram, farmers are failing to adopt for the following reasons like dissolving of DAP is time-consuming, filtering of supernatants is requiring skills. It is not compatible with plant protection chemicals. During spray, sometimes it causes severe phytotoxicity effects due to accumulation of solid form at the time of spraying as it settles after some time. Application of 0.5% mono ammonium phosphate (MAP) at flowering and 15 days after the first spray recorded higher grain and stalk yield of 1522 and 6222 kg ha-^{1} respectively and it was recorded a higher gross income of Rs. 91320, net income of Rs. 50520 and B: C ratio of 2.2. It recorded 25% higher yield over control (water spray) and 12% higher over-application of CCC 200 ppm twice at flowering and 15 days after the first spray. Hence, it concludes that due to foliar spray of phosphorus source increases the pod setting percentage and conversion of energy from source to sink.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chandrasekar CN, Bangarusamy U. Maximizing the yield of mungbean by foliar application of growth regulating chemicals and nutrients. Madras Agricultural Journal. 2003;90(1-3):142-145.
2. Latha MR, Nadanassababady T. Foliar nutrition in crops. Agric. Rev. 2003;24(3): 229-234.
3. Manivannan V, Thanunathan K, Imayavaramban V, Ramanathan N. Effect of foliar application of NPK and chelated micronutrients on rice-fallow urdbean. Legume Res. 2002;25(4):270-272.
4. Anadhakrishnaveni S, Palchamy A, Mahendran S. Effect of foliar spray of nutrients on growth and yield of greengram (*Phaseolus radiatus*). Legume Res. 2004; 27(2):149-150.

5. Anitha S, Sreenivasan E, Purushothaman SM. Response of cowpea (*Vigna unguiculata* (L) Walp) to foliar nutrition of zinc and iron in the oxisols of kerala. Legume Res. 2005;28(4):294-296.
6. Bhowmick MK, Aich A, Aich SS, Shrivastava MP, Gupta S, Man GC. Crop diversifycation through paira (utera) cropping with rabi pulses. SATSA Mukhapatra-Annual Technical Issue. 2005; 9:43-60.
7. Ganapathy M, Baradhan G, Ramesh N. Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses. Legume Res. 2008;31(2):142-144.
8. Jeyakumar P, Velu G, Rajendran C, Amutha R, Savery MAJR, Chidambaram S. Varied responses of blackgram (*Vigna mungo*) to certain foliar applied chemicals and plant growth regulators. Legume Res. 2008;31(2):110-113.
9. Somasudaram E, Mohamed Amanullah M, Vaiyapuri K, Thirukumaran K, Sathyamoorthi K. Influence of organic sources of nutrients on the yield and economics of crops under maize based cropping system. Journal of Applied Sciences Research. 2007;3(12):1774-1777.
10. Masood Ali, Mishra JP. Effect of foliar nutrition of boron and molybdenum on chickpea. Indian J. Pulses Res. 2001; 14(1):41-43.
11. Pandian BJ, Anand Kumar S, Veerabadran V, Ravichandran VK. Growth and yield of rice fallow greengram as influenced by methods of sowing, stubble management and nutrient application in Tambiraparani command area. Madras Agricultural Journal. 2001;88(7-9):406-409.
12. Srivastava GP, Srivastava VC. Effect of irrigation and foliar spray of nutrients on growth and seed yield of gram (*Cicer arietinum*). Indian Journal. Agricultural Sciences. 1994;64(4):219-222.
13. Ramesh K, Thirumurugan V. Effect of seed pelleting and foliar nutrition on growth of soybean. Madras Agricultural Journal. 2001;88:465-468.
14. Kandagal SS, Panchal YC, Manjunath S. Effect of growth regulators and nutrients on yield components of mungbean genotypes. Journal of Maharastra Agricultural University. 1990;15(2):199-200.
15. Annadurai K, Palaniappan SP. Effect of phosphorus levels and DAP spray on lowland rice field. Madras Agricultural Journal. 1994;81(11):632-633.
16. Rajendran R. Response of green gram (CO4) to soil and foliar nutrition. Madras Agric. J. 1991;78:453- 455.
17. Shetty PK, Ayyappan S, Swaminathan MS, (Eds). Climate change and sustainable food security, National Institute of Advanced Studies, Bangalore and Indian Council of Agricultural Research, New Delhi; 2013.
    [ISBN: 978-81-87663-76-8]
18. Prakash M, Kumar JS, Kannan K, Kumar MS, Ganesan J. Effect of plant growth regulators on growth, physiology and yield of black gram. Legume Res. 2003;26(3): 183-187.
19. Srivastava GP, Srivastava VC. Effect of irrigation and foliar spray of nutrients on growth and seed yield of gram (*Cicer arietinum*). Indian Journal. Agricultural Sciences. 1994;64(4):219-222.
20. Salim MM. Effect of sowing methods and foliar nutrition with urea and some micronutrients on growth and yield of soybean. Egypt. J. Agron. 1992;17:141-154.
21. Kandagal SS, Panchal YC, Manjunath S. Effect of growth regulators and nutrients on yield components of mungbean genotypes. Journal of Maharastra Agricultural University. 1990;15(2):199-200.
22. Subramani M, Solaimalai A, Velayutham A. Effect of plant population and methods of fertilizer application on yield attributes and yield of irrigated blackgram. Madras Agricultural Journal. 2002;89(4-6):305-306.
23. Anadhakrishnaveni S, Palchamy A, Mahendran S. Effect of foliar spray of nutrients on growth and yield of greengram (*Phaseolus radiatus*). Legume Res. 2004; 27(2):149-150.
24. Solaiappan U, Ramiah S. Effect of seed treatments, soil and foliar fertilization on N and P on yield attributes of pigeonpea grown under rainfed condition. Indian Journal of Agronomy. 1990;35(3):234-237.
25. Jayarani Reddy PK, Narasimha Rao L, Narasimha Rao CL, Mahalakshmi BK. Effect of different chemicals on growth, yield and yield attributes of pigeonpea in

vertisol. Ann. Plant Physiol. 2004;17(2): 120-124.

26. Ganapathy M, Baradhan G, Ramesh N. Effect of foliar nutrition on reproductive efficiency and grain yield of rice fallow pulses. Legume Res. 2008;31(2):142-144.

27. Vinothkumar C, Vaiyapuri K, Mohamed Amanullah M, Gopalaswamy. Influence of foliar spray of nutrients on yield and economics of soybean (*Glycine max* L. Merill). Journal of Biological Sciences. 2013;13(6):563-565.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/53342