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Foliar Application of Different Phosphorus Sources for Transplanted Irrigated Pigeonpea [*Cajanus cajan* (L.)] in North Western Zone of Tamil Nadu

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ABSTRACT

Field experiments were carried out to study the effect of foliar application of different sources of phosphorus on yield of transplanted redgram (*Cajanus cajan)* in June (*Kharif*) 2014 to 2015 and 2015 to 2016 at Regional Research Station, Tamil Nadu Agricultural University, Paiyur, Tamil Nadu. The treatments included different concentrations of different phosphorus sources like mono ammonium phosphate (MAP), di ammonium hosphate (DAP), all 19 as a foliar application at flowering phase. The results revealed that foliar application of 0.5% mono ammonium phosphate (MAP) at flower initiation and 15 days after first spray recorded higher growth and yield parameters such as number of branches per plant, no. of pods, no. of seeds pod ^{1} and 100 seed weight resulting in higher grain yield of 2512 kg ha^{-1}, net income of Rs. 95215/- and B:C ratio of 2.97.

Key words: All 19, Di ammonium phosphate, Foliar spray, Mono ammonium phosphate, Pigeon pea, Transplanting technology, Yield parameters.

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.)] is one of the major grain legume crops of the tropics and subtropics, endowed with several unique characteristics. It finds an important place in the cropping system adopted by small farmer in a number of developing countries. India occupies 90 per cent of world redgram area and accounts for 80 per cent of world production of redgram. According to fourth advanced estimates of 2010-11 released redgram occupies an area of 4.42 million hectares and production of about 2.89 million tones, having an average yield of 655 kg per ha. Phosphorus deficiency is usually the key factor for seed yield of pulse crops on all soil types.

Soil application of phosphate fertilizers undergoes many undesirable changes like fixation, leaching, soil acidity, alkalinity and water logging. Phosphorus is a key element involved in various functions in growth and metabolism of pulses. It is frequently a major limiting nutrient for plant growth in most Indian soils. Only a part of the phosphorus supplemented through fertilizer is utilized by the plants and a large portion of it is converted into insoluble fixed forms, the recovery efficiency of phosphorus in crops is generally 10-30% (Swarup, 2002). To overcome this problem, foliar application of nutrients is essential at crop stage. Foliar applied nitrogen and phosphorus applied have been effectively absorbed and tanslocated to the pods resulting in more number of pods per plant (Solaiappan *et al*., 2002). Presently, 2% DAP is recommended for foliar spray in pulses to prevent flower drop and better seed set. At present, inspite of several demonstrations on effect of 2% DAP spray on boosting yield in redgram, farmers are failing to adopt this technology as dissolving of DAP is time consuming, filtering of supernatants requiring skills. 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. The major benefit to the farming community is foliar nutrition reduces the cost of cultivation so that this practice leads to economizing crop production. Thangaraj (2000) indicated that foliar application of nutrient for pulses save time to fixation and immobilization in soil. The foliar application of superphosphate and DAP was found effective when compared to soil application in crops (Chandrasekar and Bangunasamy, 2003). Foliar application of nutrient and growth regulator at pre flowering and flowering stage reduced the flower drop percentage in green gram (Ganapathy *et al.* 2008). Foliar application of NAA @ 40 ppm at pre flowering stage in blackgram

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increased the plant height, number of branches and leaf area index (Jayakumar *et al.* 2008).

Application of macro and micronutrients as foliar spray at critical stages of the crop absorbed and translocated effectively to the developing pods in soybean and produced more number of filled pods (Jayabal *et al.* 1999). The foliar spray of 0.5 per cent zinc sulphate at flower initiation stage in pigeon increased the yield (400 kg ha^{-1}) by Masood Ali and Mishra (2001). Thiyageshwari and Ranganathan (1999) stated the effect of foliar application of nutrients with the recommended dose of fertilizer in soybean shown the highest seed yield of 1832 kg ha^{-1} compared to the recommended NPK (1225 kg ha^{-1}). The foliar spray of micronutrients proved to be economical in pulses (Savithri *et al*. (2001). Pandian *et al*. (2001) reported that basal dose of fertilizer with foliar spray of 2 per cent DAP at twice shown the higher plant height (73.5 cm) and net return in greengram. Phosphorus deficiency is usually the key factor for seed yield of pulses crops on all soil types. Singh and Singh (2000) sated that that foliar spray of NAA @ 30 ppm has increased the number of leaves and branches in pulses. Application of P to pulse crops must be one of the most important strategies to increase productivity of pulses in India (Ganeshamurthy *et al.,* 2003). Hence, the present investigations were carriedout to study the foliar application of different sources of phosphorus on yield and economics of transplanted redgram.

MATERIALS AND METHODS

To overcome insolubility of DAP, the present investigation was carried out to study the effect of foliar application of different sources of phosphorus on yield of transplanted red gram (*Cajanus cajan*) under irrigated conditions at Regional Research Station, Tamil Nadu Agricultural University, Paiyur, Tamil Nadu, in June (*Kharif*) 2014 to 2015 and 2015 to 2016, respectively in randomized block design with three replications. The treatments were foliar spraying of 0.5%, 1.0%,1.5% and 2.0 % mono ammonium phosphate (MAP) and 1.0%,1.5% and 2.0% 19:19:19, 1.0% pulse wonder spray, 2% DAP along with water spray (Control). Foliar spraying was done on flowering and15 days after first spray. For planting in main field, pits were formed with size of 0.15m×0.15m×0.15 m at spacing of 150 × 60 cm by using hand hoe and transplanting of redgram was done on 20.07.2014 and 25.07.2015 respectively. Planting was done with 25 days old seedlings. Irrigation was given in 7 days interval with surface irrigation methods. Foliar application of MAP (0.5, 1.0, 1.5 and 2.0%), 19:19:19 (1.0, 1.5 and 2.0%), DAP (2%) and pulse wonder (1%) were applied during flower initiation and 15 after first spraying as per the treatment schedule. The variety of LRG 41 was used for the study and its duration was 180-200 days. The observation on growth parameters was recorded in the

Table 1: Effect of foliar application of different sources of phosphorus on growth parameters of red gram (2014 and 2015).

Treatments	Plant height (cm)												No of branches $plant^{-1}$	
	30 DAS		60 DAS		90 DAS		120 DAS		150 DAS		180 DAS			
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1 - Control (water spray)	37.6	44.2	72.5	74.5	150.2	146.6	209.1	220.0	235.1	244.0	245.9	245.2	15.1	17.3
T_2 - 2.0% DAP spray on flowering and 15 days after first spray	41.0	42.0	77.6	78.2	155.4	154.0	215.2	229.2	264.0	253.5	269.1	261.2	17.3	19.5
T_3 - 0.5% MAP spray on flowering and 15 days after first spray	43.0	43.0	80.1	74.2	156.9	153.2	222.4	231.6	268.1	262.1	274.8	273.6	19.7	21.9
T_4 - 1.0% MAP spray on flowering and 15 days after first spray	43.2	42.5	79.8	81.9	156.7	153.7	221.6	223.1	266.0	251.5	272.3	272.0	18.5	20.7
T_5 - 1.5% MAP spray on flowering and 15 days after first spray	42.3	40.6	77.9	77.8	157.5	152.3	220.3	227.4	263.5	251.3	270.4	270.9	17.7	19.9
T_6 - 2.0% MAP spray on flowering and 15 days after first spray	41.0	42.5	77.2	75.0	153.9	149.2	214.4	221.8	258.3	253.8	265.2	276.5	16.8	19.0
T_7 - 1.0 % 19:19:19 spray on flowering and 15 days after first spray	41.6	45.2	77.0	74.8	156.2	146.8	215.0	221.0	260.9	256.4	268.3	270.6	16.6	18.8
T_8 - 1.5% 19:19:19 spray on flowering and 15 days after first spray	40.0	45.7	76.6	78.2	154.2	153.4	212.4	221.8	258.2	252.2	261.6	262.8	16.2	18.4
T_9 - 2.0% 19:19:19 spray on flowering and 15 days after first spray	39.3	42.4	74.4	78.1	153.7	149.2	209.2	224.4	247.2	248.8	251.3	254.8	16.2	17.4
T_{10} - 1.0% pulse wonder spray on flowering and 15 days after first spray	38.3	43.2	73.2	80.3	153.6	150.6	209.2	226.2	240.5	244.0	247.3	257.8	16.0	17.2
SEd	3.9	3.6	4.1	4.1	3.8	4.1	6.7	5.2	11.3	7.0	12.5	6.8	1.0	1.0
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	23.7	14.7	26.3	14.4	2.0	2.0

following treatments imposed on red gram at flowering phase.

RESULTS AND DISCUSSION

Growth characters

Plant height was recorded at 30, 60, 90,120,150 and 180 DAS. There was no significant variation in plant height among the treatments upto 120 DAS (Table 1). Among the different foliar sprays, application of 0.5% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_3) recorded taller plants of 268.1 and 262.1 cm and 274.8 and 273.6 cm at 150 and 180 DAS during 2014 and 2015, respectively. Control (water spray) (T_1) recorded shorter plants of 235.1and 245.9 cm and 244.0 and 245.2 cm at 150 and 180 DAS during 2014 and 2015, respectively. Regarding no. of branches, spraying of 0.5% Mono Ammonium Phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_3) recorded higher no. of branches of 19.7 and 21.9 during 2014 and 2015, respectively. Control (water spray) (T_1) recoded lower no. of branches of 15.1 and 17.3 during 2014 and 2015, respectively. Foliar spraying after 120 DAS recorded higher plant height during 150 and DAS due to better accumulation of source due to energy transfer. The growth parameters of green gram was increased due to foliar spraying of 0.5% MAP (Sivakumar *et al.*, 2019).

Yield parameters

Among the different foliar spray, application of 0.5% mono ammonium phosphate (MAP) on flowering(105 days) and 15 days after first spray (T_3) recorded higher yield parameters like number of pods/plant of 1210, no. of seeds/pod of 5.1, stem girth of 11.2 and 100 seed weight of 12.7 g at harvesting stage. This was followed by application of 1.0% mono ammonium phosphate (MAP) on flowering(105 days) and 15 days after first spray (T_4) and recorded yield parameters like number of pods/plant of 1116, no. of seeds/pod of 5.0, stem girth of 10.9 and 100 seed weight of 12.4 g at harvesting stage. Control (water spray) (T_1) recorded lower

Table 2: Effect of foliar application of different sources of phosphorus on yield parameters of redgram (pooled analysis).

Treatment	No of pods /plant	No. of seeds /pod	Stem girth (cm)	100 seed weight (g)
T_1 - Control (water spray)	983	5.0	9.0	11.6
T_2 - 2.0% DAP spray on flowering and 15 days after first spray	1013	5.0	10.2	11.7
T_3 - 0.5% MAP spray on flowering and 15 days after first spray	1210	5.1	11.2	12.7
T_4 - 1.0% MAP spray on flowering and 15 days after first spray	1116	5.0	10.9	12.4
T_5 - 1.5% MAP spray on flowering and 15 days after first spray	1084	5.0	10.4	12.4
T_6 - 2.0% MAP spray on flowering and 15 days after first spray	1039	5.0	10.3	11.7
T_7 - 1.0% 19:19:19 spray on flowering and 15 days after first spray	1017	5.0	10.2	11.8
T_8 - 1.5% 19:19:19 spray on flowering and 15 days after first spray	1007	5.0	9.7	11.9
T_9 - 2.0% 19:19:19 spray on flowering and 15 days after first spray	1006	5.0	8.9	11.8
T_{10} - 1.0% pulse wonder spray on flowering and15 days after first spray	991	5.0	8.7	11.8
SEd	87	0.07	0.9	0.3
CD(p=0.05)	183	NS	1.9	0.6

Table 3: Effect of foliar application of different sources of phosphorus on yield and economics of redgram (Pooled analysis).

Treatment	Grain yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Gross income (Rs /ha)	Cost of cultivation (Rs /ha)	Net income (Rs /ha)	B:C ratio
T_1 - Control (water spray)	1760	6056	101263	47210	54053	2.14
T_2 - 2.0% DAP spray on flowering and 15 days after first spray	2210	7463	127186	48670	78516	2.61
T_3 - 0.5% MAP spray on flowering and 15 days after first spray	2512	8228	144493	48785	95215	2.97
T_4 - 1.0% MAP spray on flowering and 15 days after first spray	2405	8096	138403	49410	88383	2.80
T_5 - 1.5% MAP spray on flowering and 15 days after first spray	2284	7642	131521	50040	81481	2.63
T_6 - 2.0% MAP spray on flowering and 15 days after first spray	2196	7352	126370	50660	75726	2.49
T_7 - 1.0% 19:19:19 spray on flowering and 15 days after first spray	2251	7463	129596	49210	80386	2.64
T_8 - 1.5% 19:19:19 spray on flowering and 15 days after first spray	2080	6946	119702	49735	68295	2.40
T_9 - 2.0% 19:19:19 spray on flowering and 15 days after first spray	2018	6756	116085	50260	65930	2.31
T_{10} - 1.0% pulse wonder spray on flowering and 15 days after first spray	1857	6481	106910	50160	56750	2.22
SEd	81	221	-	-	-	-
CD (p=0.05)	171	465	NA	NA	NA	NA

number of pods/plant of 987, no. of seeds/pod of 5.0, stem girth of 9.0 cm and 100 seed weight of 11.6 g. (Table 2). The higher values of yield and yield attributes may be as cribbed to the effect of P on root development, energy transformation and metabolic processes of the plant, which in term resulted in greater translocation of photosynthates towards the sink development (Singh and Ahlawat, 2007), (Manivannan *et al.,* 2002) and (Prakash *et al.,*2003).

Pooled analysis

Pooled analysis was done for grain yield and stalk yield (Table 3). Regarding yield, application of 0.5% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_3) recorded grain and stalk yield of 2512 and 8228 kg ha^{-1} respectively. Control (water spray) (T_1) recoded lower number grain and stalk yield of 1760 and 6056 kg ha^{-1} respectively. Application of 0.5% mono ammonium phosphate (MAP) on flowering(105 days) and 15 days after first spray (T_3) recorded 4% higher over application of 1.0% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_4) and 29% higher yield over Control (water spray). (T_1). Phosphorus application had increased the yield of redgram (Malarmathi and Thomas Abraham, 2003).Foliar application of 1% DAP + 0.5% urea recorded higher number of pods/plant in irrigated blackgram (Subramani *et al.,* 2002).

With regard to economics, application of 0.5% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray recorded higher net income and B:C ratio of Rs.95215/- and 2.97, respectively. The economics was increased due to application of 0.5% MAP (Sivakumar *et al.* 2019).

This was followed by application of 1.0% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_4), which recorded a net income and B:C ratio of Rs. 88383/- and 2.80, respectively. Control (water spray) (T_1) recoded lower net income and B:C ratio of Rs. 54053/- and 2.14, respectively.

CONCLUSION

Application of 0.5% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_3) recorded higher growth and yield parameters *viz*., number of branches per plant per plant, no. of pods per plant, no. of seeds per pod and 100 seed weight resulting in higher grain yield of 2512 kg ha^{-1}, net income of Rs. 95215/- and B:C ratio of 2.97. Thus, application of 0.5% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_3) recorded 4% higher over application of 1.0% mono ammonium phosphate (MAP) on flowering (105 days) and 15 days after first spray (T_4) and 29% higher yield over control (water spray) (T_1).

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