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Foliar application of potassium on the growth and yield components of pigeonpea (*Cajanus cajan* (L.) Millsp.)

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Abstract. The effect of foliar application of potassium on the growth pattern and yield components of three cultivars of pigeonpea (*Cajanus cajan* (L.) Millsp.), were studied. Potassium increased plant height and dry matter accumulation in all the three cultivars. Days to maturity was not much effected. Potassium increased yield in all the cultivars but at different levels. Flower drop was reduced conspicuously. However among the cultivars studied, cv.PDM1 showed better response than the others.

Keywords. *Cajanus cajan*; foliar application; plant height; flower drop; yield components.

1. Introduction

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is the second-most important pulse crop of India. However, the yield potential of pigeonpea has not been fully exploited. Though it is well established that yield is intimately associated with mineral nutrition of crop plants (Kilmer *et al* 1968; Epstein 1972; Gauch 1972; Hewitt and Smith 1974), adequate information is not available on this aspect of pigeonpea (El Baradi 1978). It is generally considered that pigeonpea does not respond to potassium fertilizers (Kulkarni and Panwar 1980). Since these studies were based on soil applications, the present investigation was undertaken to study the foliar application of potassium on the growth and yield components of pigeonpea.

2. Material and methods

2.1 *Plant material*

Seeds of *Cajanus cajan* (L.) Millsp. cv.PDM1, cv.LRG30 and cv.ST1, all late maturing varieties, were obtained from APPSDC, Hyderabad. The seeds were sown 4 cm deep in 100 m^2 plots, with a spacing of 75 cm between the rows and 50 cm between the plants within the row. The potassium (K_2O) status of the soil is 310 kg/ha. In this field experiments, pigeonpea was grown as a sole crop. Certain plots were selected as controls which were sprayed with distilled water and others were considered as treatment plots, in which the plants were supplied with 10 mM KCl as a foliar spray. Foliar application of potassium during early hours of the day was carried out throughout the growth period with a 15-day interval. The crop was subjected to normal irrigation and recommended farmyard manure. For recording the data on each parameter 10 plants were collected from each plot of three replications and mean values were presented.

2.2 *Plant height*

The data on plant height measurements were collected at every 15-day interval.

2.3 *Dry matter accumulation*

For dryweight determination, the samples were kept in a hot air oven maintained at 80°C for 48 hr when constant dryweights were obtained. For the total leaf dryweight, the weight of fallen leaves were also recorded. Further an unavoidable source of error was obtained in uprooting the plants.

2.4 *Leaf area*

Leaf area was estimated by plotting the outline of leaves on a mm graph paper.

2.5 *Yield components*

The number of flowers opened and the number of pods initiated were counted every morning. After harvesting the plants the yield components like number of pods and number of seeds per plant were recorded.

3. Results and discussion

The growth pattern of three cultivars of pigeonpea is shown in table 1. Plant height increased with age in all cultivars up to 120 days and thereafter remained constant. Cultivar PDM1 always recorded higher values in height followed by cv.LRG30 and cv.ST1. Potassium treatment increased plant height in all the cultivars. It is now firmly established that potassium participates in several processes associated with growth (Kilmer *et al* 1968; Hewitt and Smith 1974). Potassium is considered to increase cell expansion resulting in growth (Dhindsa *et al* 1975; Cram 1976). The leaf area per plant increased with age up to 120 days in cv.PDM1 and cv.LRG30 whereas in cv.ST1, it continued to increase up to 135 days followed by a decline (table 1). All potassium treated cultivars showed a significant leaf area increase. The increase was 40% in cv.PDM1, 35% in cv.LRG30 and 31% in cv.ST1. Application of potassium increases cell expansion by regulating the solute potential and consequently the turgor potential (Dhindsa *et al* 1975) which may probably increase the rate of leaf area expansion and eventually the total leaf area per plant.

Dry matter accumulation of the whole plant, leaf, stem, and root increased with age in all the cultivars (figure 1). Among the cultivars PDM1 recorded higher dry matter accumulation than LRG30 and ST1. Potassium treatment increased dry matter accumulation in all the cultivars when compared to their respective control plants. Potassium supply resulted in increased shoot and root dryweights of other plants also (Barta 1982). The higher dry matter accumulation in the treatments may be due to increased photosynthesis (Moss and Peaslee 1965; Cooper *et al* 1967), followed by efficient translocation of photosynthates (Haeder and Mengel 1972) involving potassium.

The total number of flowers recorded per plant were highest in cv.PDM1. In all cultivars potassium treated plants showed low percentage of flower drop than their

Table 1. Effect of foliar application of potassium on plant height and leaf area during pigeonpea plant growth (± mean with SE).

Para-meter	Variety	Age in days											
		30		60		90		120		150		180	
		CON	K^+	CON	K^+	CON	K^+	CON	K^+	CON	K^+	CON	K^+
Plant height (cm)	cv.PDM1	22·61 ±0·89	26·34 ±1·71	95·25 ±2·36	97·82 ±1·96	161·20 ±1·64	171·72 ±1·65	194·40 ±1·92	202·80 ±3·08	198·90 ±1·75	208·60 ±1·88	199·75 ±2·10	209·20 ±1·64
	cv.LRG30	20·16 ±0·78	21·70 ±1·82	91·45 ±1·41	93·25 ±3·78	162·84 ±1·72	170·52 ±1·94	191·96 ±1·55	202·68 ±2·11	196·75 1·12	203·96 ±2·07	197·12 ±3·14	205·40 ±2·87
	cv.ST1	22·44 ±1·11	24·72 ±1·21	98·53 ±1·65	103·78 ±2·05	169·40 ±1·47	176·80 ±1·50	189·56 ±2·32	194·32 ±2·20	192·70 ±1·89	199·30 ±1·53	193·40 ±1·04	200·10 ±2·56
Leaf area (cm^2/plant)	cv.PDM1	96·81 ±9·07	142·37 ±13·77	389·69 ±9·90	576·84 ±12·25	1434·40 ±16·15	2884·21 ±11·57	2653·24 ±8.71	4418·37 ±7·21	1036·42 ±14·12	3006·95 ±7·32	776·07 ±14·21	2503·74 ±13·11
	cv.LRG30	68·70 ±6·91	105·03 ±8·42	511·68 ±12·31	939·74 ±13·00	1445·37 ±9·01	2971·25 ±10·12	2581·15 ±7·91	4007·72 ±8·05	981·42 ±12·12	2211·15 ±16·24	757·48 ±8·41	1449·69 ±9·91
	cv.ST1	76·68 ±11.12	111·79 ±14·12	585·61 ±9·21	813·01 ±7·84	1630·72 ±8·21	2653·60 ±12·21	2419·95 ±13·41	3524·20 ±9·71	1018·07 ±8·41	1431·81 ±14·56	630·66 ±10·34	1203·71 ±11·71

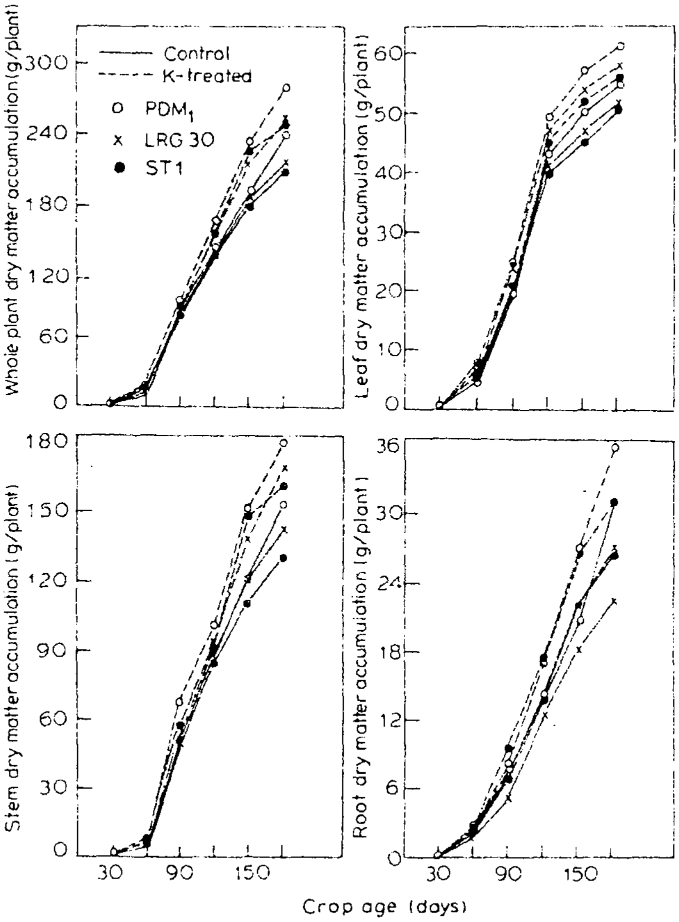

Figure 1. Effect of foliar application of potassium on dry matter accumulation of whole plant and parts of pigeonpea.

respective control plants (table 2). The flower drop recorded in control cv.PDM1, cv.LRG30 and cv.ST1 was 87·48, 84·38 and 84·42% respectively. Interestingly the flower drop reduced to 74·54% in cv.PDM1, 77·16% in cv.LRG30 and 77·48% in cv.ST1, which is always correlated with increased yield. The reduction in flower drop may be due to probable improved water relations and hormonal balance by potassium application. This response is more in cv.PDM1, followed by cv.LRG30 and cv.ST1. In all cultivars, potassium treatment resulted in increased pod number. Among potassium treated cultivars the pod number was more in cv.PDM1 followed by cv.LRG30 and cv.ST1. This is in agreement with the low percentage of flower drop in cv.PDM1. However, days to maturity and the number of seeds per pod were not altered by potassium treatment. Among potassium treated cultivars, cv. PDM1 showed higher grain yield per plant followed by cv.LRG30 and cv.ST1 (table 3). Cultivar PDM1 showed 47·73%, cv.LRG30 38·09% and cv.ST1 35·16% increase in grain yield as a result of foliar application of potassium. A similar trend of grain yield was also observed on per acre basis (table 3).

Table 2. Effect of foliar application of potassium on the flower production, flower drop and total pod number/plant in pigeonpea.

Variety	Total flower production		Flower drop %		Total pod number	
	CON	K^+	CON	K^+	CON	K^+
cv.PDM1	855	868	87·48	74·54	107·7	221·00
cv.ST1	614	631	84·42	77·48	99·83	142·00
cv.LRG30	752	762	84·38	77·16	119·22	174·33

Table 3. Effect of foliar application of potassium on yield components of pigeonpea cultivars.

Parameter	cv.PDM1		cv.LRG30		cv.ST1	
	CON	K^+	CON	K^+	CON	K^+
Leaf area (cm^2)	776·07	2503·74	757·48	1449·69	630·66	1203·71
Days to maturity	107	103	118	114	106	101
Number of pods/plant	107·7	221	119·22	174	99·83	142
Number of seed/pod	4	4	4.08	3·72	3·73	4·01
Number of seed/plant	428	884	486	647·28	370	568
Grain yield (g/plant)	31·62	60·50	31·71	51·22	29·5	45·5
Grain yield (kg/acre)	332·70	636·75	333·64	538·92	310·39	478·74

Pigeonpea showed a good response to the foliar application of potassium. Foliar nutrition may afford a remedy in situations in which the time-lag between soil application of fertilizers and plant absorption may be too long to satisfy the needs of fast growing annual crops during periods of intense growth (Noggle and Fritz 1976).

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