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Drought Management Options for Rainfed Pigeonpea in *Alfisols*

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ABSTRACT : Field experiments were conducted during two *kharif* seasons in the year 1995-96 in *Alfisols* at Central research Institute for Dryland Agriculture, Hyderabad. The results indicated that medium duration pigeonpea (LRG-30) recorded higer yield by 70 percent than short duration pigeonpea (ICPL-87) in both rainfed and strees free environments. Among the management practices, stress free pigeonpea on an average, recorded 68 percent additional seed yield compared to rainfed environment. Supplemental irrigation of 5 cm at early (vegetative), mid (flowering) and terminal (pod formation) periods gave 31, 42 and 49 percent increased seed yield respectively over rainfed crop. Establishing a soil mulch through additional interculture practices at early and mid stress periods gave yield advantage to an extent of 12 and 19 per cent respectively compared to no soil mulch. Application of additional 10 kg N ha^{-1} after relieving the moisture stress at vegetative and flowering periods enhanced the seed yields of pigeonpea by 19 and 29 percent respectively compared to control. Thus, yields of rainfed pigeonpea in *Alfisols* can be stabilized to a certain extent through interculture (low monetary input) during early and mid moisture stress period and by additional nitrogen application (monetary input) after the relief of early and mid stress period.

Key words: Pigeonpea, supplemental irrigation, stressed and stress free situations

Moisture stress is a common recurring phenomenon in rainfed crops. The moisture stress during intermittent crop growth periods causes yield reduction and fluctuations in crop yields in rainfed environment, which can be minimized by selecting drought tolerant crops and varieties to match the growing season, screening of genotypes for drought tolerance and evolving appropriate agro-techniques for stabilizing yields (Subba Reddy *et al.*, 1996)

Pigeonpea is an important pulse crop grown widely as sole crop and intercropped in rainfed *Alfisols*. The reduction in yield of pigeonpea depends upon the degree and intensity of drought spell and also the stage of crop growth which the crop experiences. Hence, there is a need to study the various management options with different genotypes of pigeonpea for stabilizing monetary returns in rainfed situations

Materials and Methods

The experiment was carried out at Central Research Institute for Dryland Agriculture (CRIDA) farm during two *Kharif* seasons of 1995-96. The experimental site was sandy loam in texture, neutral in pH, low in available nitrogen (210 kg ha^{-1}). Pigeonpea varieties ICPL-87 and LRG-30 were sown during the second fortnight of June in rows 60cm apart in each season. The crop received 10 kg N and 30 kg $P_2O_5ha^{-1}$ as basal dose and standard agronomic measures were adopted. The treatments comprising of management practices viz., additional interculture during moisture stress at vegetative (S1) and flowering stages (S2); additional nitrogen 10 kg N ha^{-1} after relief of moisture stress at both vegetative (S1) and flowering stages (S2) and supplemental irrigation of 5 cm during stress periods (S3) were evaluated in a randomized block design with three replications. The growth parameters viz., drymatter, leaf area index (LAI) yield and yield components such as pod bearing zone, contribution of nitrogen through leaf litter were estimated. Rainfall use efficiency (RUE) was also calculated (Jorge Elizondo-Barron, 1991).

Rainfall Pattern

The genotypes ICPL-87 and LRG-30 received about 500 and 738 mm of rainfall during their crop growth periods in first season respectively. The short duration

ICPL-87 underwent moisture stress for 12-15 days at vegetative, flowering and pod formation stages of crops, while medium duration pigeonpea (LRG-30) experienced intermittent dry spells of 12, 25 and 40 days in early (0-45 DAS), mid (45-90 DAS), mid (45-90 DAS) and terminal (90-120 DAS) growth stages. But the rainfall of 43 mm received in November helped to improve the grain filling in LRG-30.

In second season, ICPL-87 and LRG-30 received about 540 and 845 mm of rainfall during their respective growth periods. ICPL-87 experienced dry spells of 10 and 15 days during vegetative phase. Medium duration LRG-30 underwent moisture stress >14 days at vegetative phase, 15 days at flowering and >45 days at pod filling. However, the rainfall of 41 mm received on 8th November helped to get improved seed yields of LRG-30.

Results and Discussion

The medium duratin pigeonpea (LRG-30) recorded higher yield than short duration genotype (ICPL-87) in both rainfed and stressed environments. In rainfed systems, medium duration pigeonpea gave 70 and 62 percent higher seed yield than short duration genotype in first and second season respectively (Table 1). On an average, ICPL-87 and LRG-30 after harvest contributed 28 and 40 Kg N ha^{-1} to the soil through leaf litter in rainfed and stress free environments respectively (Table 2). Similar increment in stalk yields and gross returns were noticed in both the years.

During the first season, among the management practices, additional interculture during early and mid moisture stress gave higher seed yield of 42 and 89 Kg ha^{-1} respectively than no interculture in rainfed ICPL-87 (524 Kg ha^{-1}). Application of additional nitrogen @ 10 Kg N ha^{-1} after relief of early and mid stress periods gave additional seed yields of pigeonpea by 70 and 154 Kg ha^{-1} in rainfed conditions. The yield gains with additional interculture and additional nitrogen in both early and mid moisture periods was higher in medium duration genotype (LRG-30) compared to short duration genotype (ICPL-87). Supplementary irrigation of 5 cm during early, mid and terminal stress periods increased the seed yields by 199, 236 and 278 $Kgha^{-1}$ in ICPL-87 and 531, 576 and 720 Kg ha^{-1} in LRG-30 respectively over corresponding genotypes in rainfed environment (Table1).

Additional interculture during intermittent dry spells at vegetative phase (early moisture stress) increased the seed yield of LRG-30 and ICPL-877 by 3 and 7 per cent respectively over no additional interculture in second season. Increased seed yields of 9 and 13 percent were recorded with additional interculture during mid stress period (60-90 DAS) in LRG-30 and ICPL-87 respectively over control. Application of nitrogen @ 10 Kg N ha^{-1} after relief of moisture stress at vegetative and flowering periods gave higher seed yields in ICPL-87 by 14 and 24 per cent over rainfed environment. Supplementary irrigation of 5 cm each during moisture stress at vegetative (early), flowering (mid) and grain filling (terminal) stages recorded higher yield in ICPL-87 by 22,40 and 50 per cent respectively compared to stressed environment. In LRG-30, supplemental irrigation of 5 cm at vegetative, flowering and pod formation stages recorded increased yield benefit to the tune of 11, 22 and 28 per cent over control. Supplemental irrigation of 5 cm either at early or mid or terminal stages recorded the highest yield benefit in both the genotypes during both the years followed by the application of additional 10 Kg N after relief of early and mid moisture stress. Increased yield of pigeonpea genotypes due to varied management practices is attributed to efficient utilization of rainfall as evidenced by Rainfall Use Efficiency (RUE), (Table 2) and also yield components (pod bearing zone). The partitioning of photosynthates in realizing the yield is more in medium duration pigeonpea than short duration pigeonpea (Vijayalakshmi, 1983; Subba Reddy *et al.*, 1996, Oguneremi, 1996). Thus, the study indicated that moisture stress during flowering and grain formation stages are critical in influencing the yield of rainfed pigeonpea in short and medium duration genotypes under rainfed environment. The highest increase in pigeonpea yields with supplemental irrigation was due to higher compensation of drymatter production, better utilization of moisture through higher RUE and light after relief or stress periods. (AICRPDA, 1999). In both the years, maximum gross returns were obtained from the management practices such as additional interculture during early and mid moisture stress stages than without interculture in both medium (LRG-30) and short duration (ICPL-87) genotypes (Table 1). Gross returns from the crop with additional interculture, additional nitrogen in both early and mid moisture stress periods and supplementary irrigation of 5 cm during early, mid and terminal stress periods were higher in medium

Table 1. Effect of drought management practices on yield and gross return n rainfed pigeonpea

Treatments	Seed Yield (kg ha^{-1})				Stalk Yield (kg ha^{-1})				Gross returns (Rs. ha^{-1})			
	1995		1996		1995		1996		1995		1996	
	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30
1. Rainfed (Control)	254	959	842	1364	2512	4982	2778	5324	6288	11508	10104	16368
2. Addl. I.C. at S1	566	1272	899	1405	3068	5232	3125	5450	6792	15264	10786	16860
3. Addl. I.C. at S2	613	1325	950	1489	3162	5175	3048	5710	7356	15900	11400	17868
4. Addl. No. (10 kg/ha) after relief of stress at S1	594	1350	962	1469	3275	5319	3420	5625	7128	16200	1544	17628
5. Addl. N (10 kg/ha) after relief of stress at S2	678	1420	1085	1560	3462	5979	3520	6244	8136	17040	13020	18720
6. S.I. 5 cm at S1	723	1590	1024	1511	3612	6212	3472	6481	8676	19080	12288	18132
7. S.I. 5 cm at S2	760	1635	1180	1659	3860	6319	3612	6472	9120	19620	14160	19908
8. S.I. 5 cm at S3	802	1679	1260	1747	3691	6531	3472	6420	9624	20148	15120	20964
9. S.I. 5 cm at S1+S2+S3	1050	1980	1330	1825	3271	6970	3125	7060	12600	23760	15960	21900
C.D. (0.05)	161	303	113	96	756	989	896	1062	1250	1360	800	1050

S1 : Stress at vegetative stage; S2 Stress at flowering stage; S3 : Stress at grain formation stage
IC : Intercultural; S.I. : Supplemental irrigation

Table 2. Effect of drought management practices on rainfall use efficiency, N contribution and pod bearing in rainfed pigeonpea

	RUE (kg ha^{-1} mm^{-1})				N contribution through leaf litter (kg ha^{-1})				Pod bearing zone (cm/branch)			
Treatments	1995		1996		1995		1996		1995		1996	
	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30	ICPL-87	LRG-30
1. Rainfed (Control)	1.05	1.30	1.49	2.15	15.2	25.1	18.4	28.6	28.75	51.70	31.20	63.12
2. Addl. I.C. at S1	1.13	1.72	1.60	2.21	16.3	28.3	19.5	30.1	32.7	52.60	33.50	64.63
3. Addl. I.C. at S2	1.23	1.79	1.68	2.34	17.1	29.7	22.8	32.5	30.75	53.72	34.62	70.22
4. Addl. N at S1	1.19	1.83	1.70	2.31	18.3	32.5	21.7	36.6	31.92	54.92	33.90	67.27
5. Addl. N at S2	1.35	1.92	1.98	2.45	19.6	33.6	22.0	38.7	32.75	56.12	34.12	72.25
6. S.I. 5 cm at S1	1.45	2.15	1.61	2.38	20.1	34.7	23.6	42.6	34.92	58.12	35.72	66.69
7. S.I. 5 cm at S2	1.52	2.22	1.76	2.43	21.3	35.0	24.7	41.6	37.92	61.32	36.42	73.94
8. S.I. 5 cm at S3	1.60	2.28	2.20	2.54	20.1	30.1	22.2	38.2	39.75	62.75	37.39	73.00
9. S.I. 5 cm at S1+S2+S3	2.10	2.68	2.00	2.22	24.3	36.1	26.7	43.9	40. 72	65.92	39.42	77.00
C.D. (0.05)	0.56	0.62	0.38	NS	5.9	7.1	6.02	8.05	10.75	10.00	6.90	7.38

S1 : Stress at vegetative stage; S2 Stress at flowering stage; S3 : Stress at grain formation stage
IC : Intercultural; S.I. : Supplemental irrigation

duration genotype (LRG-30) than the short duration (ICPL-87) one in both years. Soil mulch through additional interculture registered additional gross income by 32 and 38 percent respectively over control during early and mid stress periods in medium duration pigeonpea by conserving moisture (AICRPDA, 2000).

It can be concluded from this study that the yields of rainfed pigeonpea in *Alfisols* can be stabilized by 15-30 per cent through extra interculture (low monetary input) or extra nitrogen application (monetary input) after relief of early stress.

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