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Original Research Article

Influence of Drip Fertigation and Season on Resultant Seed Quality Attributes of Pigeonpea

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ABSTRACT

A study was conducted in 2010 and 2011 to study the effect of drip fertigation and season on resultant seed quality in kharif and summer crops of pigeonpea (Cajanus cajan L.) cv. VBN 3. Data were collected on 100 seed weight, germination, seedling length, dry matter production and vigour index in the pigeonpea resultant seeds evaluated in both season. Significant drip fertigation and seasonal effects on seed quality attributes in the resultant seeds of pigeonpea were obtained. In general, kharif season crop recorded higher seed quality than the summer season crop. The results revealed that fertigation exhibited significant effect on seed quality parameters. Among the treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} resultant seed quality were recorded higher physiological seed quality as compared to T_1, T_2, T_3 and control in both season. Seed weight, seed germination, seedling length, dry matter production and vigour index could be taken as parameters for improving seed quality potential in kharif season.

Key Words: Cajanus cajan L, drip fertigation, kharif, summer, resultant seed, seed quality attributes

INTRODUCTION

Pigeonpea is extensively grown crop in the nation. With 22 per cent protein, which is nearly three times that of cereals, pigeonpea supplies a major share of protein requirement of the predominantly vegetarian population in the country. Pigeonpea is cultivated in more than 25 tropical and subtropical countries, either as a sole crop or intermixed with cereals or with legumes. Being a legume, pigeonpea enriches soil through symbiotic nitrogen fixation. Fertigation is a relatively new but revolutionary concept that helps to achieve both fertilizer-use and water-use efficiency. Its precise application of soluble fertilizers through drip irrigation increases nutrient absorption by plants, reduces wastage, negates soil pollution, reduces pollution of water table through fertilizer leaching and saves money for the farmer. [1] Increased seed yield and quality are added benefits accruing from precise utilization of costly inputs. Hence, drip fertigation will play a vital role in agricultural scenario in future. The environment interaction plays a very important role in desired seed production. These episodes of extreme events could impose different degrees of drought stress conditions on the crop and affected growth duration, plant size, dry matter production; assimilate reserves and partitioning to seeds in crops. [2,3] In crops, traits such as biomass accumulation and capacity for assimilate reserve and mobilization to reproductive structures (seed) are important to the survival, crop functioning and hence its productivity under variable soil water and thermal regimes of the sowing seasons. [4] At present, the knowledge regarding the effect of environmental factors on seed production is meager. Pigeon pea is known to be sensitive to photoperiod and temperature and the plant morphology, reproductive changes with the environment, particularly the temperature. Hence, it is necessary to identify the best season which are suited to changes in the environment on sustained production. Keeping this in view, an investigation was carried out to study the effects of drip fertigation and season on resultant seed quality in pigeonpea.

MATERIALS AND METHODS

An experiment on effect of drip fertigation and season on resultant seed quality of pigeonpea was carried during kharif, 2010 and summer, 2011 at Agricultural College and Research Institute (TNAU), Madurai. After harvest the kharif crop and summer crop resultant seeds of pigeonpea were separated based on the drip fertigation combined with foliar spray treatments and season were subjected to physiological seed quality evaluation and present findings evidently brought out the superior performance of resultant seeds from drip fertigation treatments. The details of treatments are as follows:

T_1- 50% of SRDF through drip + FS of 0.5% Zinc sulphate

T_2 - 50% of SRDF through drip + FS of 100 ppm succinic acid

T_3 - 50% of SRDF through drip + FS of 100 ppm humic acid

T_4 - 75% of SRDF through drip + FS of 0.5% zinc sulphate

T_5 - 75% of SRDF through drip + FS of 100 ppm succinic acid

T_6 - 75% of SRDF through drip + FS of 100 ppm humic acid

T_7 - 100% of SRDF through drip + FS of 0.5% zinc sulphate

T_8 - 100% of SRDF through drip + FS of 100 ppm succinic acid

T_9 - 100% of SRDF through drip + FS of 100 ppm humic acid

T_{10} - 150% of SRDF through drip + FS of 0.5% zinc sulphate

T_{11} - 150% of SRDF through drip + FS of 100 ppm succinic acid

T_{12} - 150% of SRDF through drip + FS of 100 ppm humic acid

Control - surface irrigation with SRDF of 25:50:25 NPK kg ha^{-1}

*FS- foliar spray, SRDF: Seed recommended dose of fertilizers

The resultant seeds were evaluated for their seed quality characters such as standard seed germination percent, seed vigour index as per the standard procedure of International Seed Testing Association. [5] In laboratory condition seed germination test was conducted by between paper method and maintained at controlled environment conditions i.e., 25°C temperature and 70% relative humidity during experiment. The germination percent was recorded after six days of sowing. Seedling vigour was computed by multiplying seedling length and dry matter production. [6] Dry matter production (g·seedlings−10) dried in a hot air oven maintained at 85°C for 48 h and cooled in a dessicator for 30 min and weighed in an electronic digital balance. The data was analysed for 'F' test of significance following the statistical methods described by Gomez and Gomez. [7] The critical differences (CD) were calculated at 5% probability level. The data were tested for statistical significance (*). If F test is non-significant, it was indicated as NS.

RESULTS AND DISCUSSION

The statistical scrutiny on quality characters revealed that for all the characters studied surface drip fertigation significantly increased the physiological seed characters of pigeonpea viz., 100 seed weight (g), germination (%), root length, shoot length, dry matter production (mg) and vigour index over the seasons. Among the drip fertigation treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} resultant seed quality were registered higher seed physiological quality potential as compared to T_1, T_2, T_3 in both crops. While all the seed quality attributes were lower in control plot (soil application of 100% SRDF) as compared to drip fertigation treatments in kharif and summer crop.

Table 1: Influence of drip fertigation and season on 100 seed weight (g) in pigeonpea in kharif and summer season

F- Fertigation Treatments	100 seed weight (g)							
	FS - Foliar spraying treatments							
	Kharif 2010 (S)				Summer 2011 (S)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	7.5	7.5	7.5	7.5	7.3	7.3	7.3	7.3
F_2	7.7	7.7	7.7	7.7	7.4	7.4	7.4	7.4
F_3	7.9	7.9	7.8	7.8	7.5	7.5	7.5	7.5
F_4	7.8	7.7	7.7	7.7	7.5	7.5	7.5	7.5
Mean	7.7	7.7	7.7	7.7	7.4	7.4	7.4	7.4
	F	FS	F X FS	FS X F	F	FS	F X FS	FS X F
SEd	0.067	0.054	0.111	0.109	0.022	0.029	0.052	0.059
CD(P=0.05)	0.163**	NS	NS	NS	0.053**	NS	NS	NS
Absolute Control	7.5				7.2			

Table 2: Influence of drip fertigation and season on germination (%) in pigeonpea in kharif and summer season

F- Fertigation Treatments	Germination (%)							
	FS - Foliar spraying treatments							
	Kharif 2010 (S)				Summer 2011 (S)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	93	93	93	93	90	90	90	90
F_2	96	96	96	96	92	92	92	92
F_3	96	96	96	96	92	92	92	92
F_4	96	96	96	96	92	92	92	92
Mean	95	95	95	95	92	92	92	92
	F	FS	F X FS			FS	F X FS	
SEd	0.664	0.575	1.151		0.629	0.545	1.090	
CD(P=0.05)	1.371*	NS	NS		1.298*	NS	NS	
Absolute Control	93				90			

The results of Table 1 were followed. Among the seed quality characters, 100 seed weight was higher for the seeds obtained from kharif crop recorded 7.7g than summer crop 7.4g. The results are in conformity with that of Pressman et al. [8] in plants, it is reported that pollination and subsequent ovary and seed development are linked with direct stress effects of high temperatures and soil moisture deficits which enhance plant water stress at pollination time. The higher seed weight during kharif was attributed to better mineral utilization of plants accompanied with enhancement photosynthesis and greater diversion of food material to seeds. [9] Among the treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} resultant seed quality were higher as compared to T_1, T_2, T_3 in both season. These findings are in agreement with the Hebbar et al. [10] who reported that the higher seed yield and quality correlating with higher level of water soluble fertilizers could be attributed to translocation of more carbohydrates due to high nitrogen levels. The results of Table 2 were followed. Seed germination was evenly improved by T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} (96% in kharif season and 92% in summer season crop) and maximum germination was noticed in kharif crop. These results are in harmony with those of [11,12] who worked on different sowing date of okra and also in agreement with those results and also obtained by Rengel, [13] stated that the increase in 1000 grain weight and its ultimately reflects higher seed germination of crop plants might be due to zinc that has high phloem mobility from leaves to roots, stem and developing seeds.

The results of Table 3&4 were followed. The similar trend was noticed in seedling length in kharif crop 38.6 cm and 36.7 cm in summer crop. Among the treatments maximum seedling length was recorded by 75 per cent SRDF as WSF, 100 per cent SRDF as WSF and 150 per cent SRDF as WSF in both season. The higher seed quality attributes correlating with higher level of water soluble fertilizers could be attributed to translocation of more carbohydrates due to high nitrogen levels. This study supported the possibility that potassium plays an important role in this translocation of metabolites for the development of seed. Moreover, these results are in conformity with chavan [14] and Darwati et al. [15] in sesame. The results of Table 5 were followed. Moreover, surface drip fertigation treatment also increased the seedling dry weight due to better mobilization of nutrients to seed to seedling in kharif crop 54.4mg and 52.6 mg in summer, and dry matter production (10 seedling^{-1}) were higher in kharif season by 3.6 % over summer season which might be due to the prevalence of favorable temperature during the early and late stages of crop growth that prevailed in kharif season crop. Similar results were also reported by Yadav and Dhankar. [16]

Table 3: Influence of drip fertigation and season on root length (cm) in pigeonpea in kharif and summer season

F- Fertigation Treatments	Root length (cm)							
	FS - Foliar spraying treatments							
	Kharif 2010 (S)				Summer 2011 (S)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	13.4	14.3	12.4	13.4	12.6	12.4	13.5	12.8
F_2	16.0	15.6	15.4	15.7	14.6	14.8	15.2	14.9
F_3	16.0	15.8	16.4	16.1	15.2	15.0	15.6	15.3
F_4	16.0	16.2	16.3	16.2	15.2	15.4	15.5	15.4
Mean	15.4	15.5	15.1	15.3	14.4	14.4	15.0	14.6
	F	FS	F X FS		F	FS	F X FS	
SEd	0.585	0.507	1.014		0.707	0.612	1.224	
CD(P=0.05)	1.208**	NS	NS		1.459**	NS	NS	
Absolute Control	13.0				12.5			

Table 4: Influence of drip fertigation and season on shoot length (cm) in pigeonpea in kharif and summer season

F- Fertigation Treatments	Shoot length (cm)							
	FS - Foliar spraying treatments							
	Kharif 2010 (S)				Summer 2011 (S)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	21.5	22.0	21.3	21.6	20.2	20.7	20.0	20.3
F_2	24.2	23.6	23.2	23.7	23.0	22.4	22.0	22.5
F_3	24.5	24.1	24.6	24.4	23.3	22.9	23.4	23.2
F_4	23.3	23.8	23.4	23.5	22.3	22.6	22.4	22.4
Mean	23.4	23.4	23.1	23.3	22.2	22.2	22.0	22.1
	F	FS	F X FS		F	FS	F X FS	
SEd	0.512	0.444	0.888		0.424	0.367	0.735	
CD(P=0.05)	1.058**	NS	NS		0.876**	NS	NS	
Absolute Control	21.5				20.0			

Table 5. Influence of drip fertigation and season on dry matter production (mg) in pigeonpea in kharif and summer season

F- Fertigation Treatments	DMP- Dry matter production (mg)							
	FS - Foliar spraying treatments							
	Kharif 2010 (S)				Summer 2011 (S)			
	FS_1	FS_2	FS_3	Mean	FS_1	FS_2	FS_3	Mean
F_1	52.4	52.5	51.7	52.2	50.4	50.5	50.7	50.5
F_2	54.1	55.0	55.2	54.8	53.2	52.3	53.5	53.0
F_3	55.4	55.4	55.3	55.4	54.2	54.9	53.2	54.1
F_4	55.0	55.4	55.4	55.2	52.1	52.4	53.1	52.6
Mean	54.2	54.5	54.4	54.4	52.5	52.5	52.6	52.6
	F	FS	F X FS		F	FS	F X FS	
SEd	0.846	0.733	1.466		0.904	0.783	1.565	
CD(P=0.05)	1.747*	NS	NS		1.865*	NS	NS	
Absolute Control	51.4				50.4			

The results of Figure 1 were followed. Vigour index was higher in kharif season crop (5181) as compared to (4809) in summer season. Among the treatments 75 per cent SRDF as WSF, 100 per cent SRDF as WSF and 150 per cent SRDF as WSF registered higher vigour index values were higher by 9.1 per cent in kharif crop as compared to 50% SRDF as WSF in summer crop. Among the treatments, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} were better in both seasons. In India, showed that the maximum temperature and sun shine hours affected initial growth and flower production which ultimately its affect the seed quality characters. Several studies showed that sowing season significantly affected crop growth, flowering and resultant seed quality which was mainly attributed to influences of temperature. [17,18]

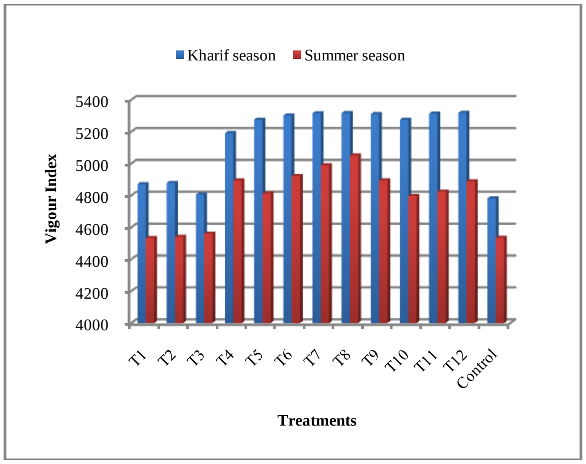

Figure 1. Influence of fertigation and season on vigour index of pigeonpea in kharif and summer season

CONCLUSION

From the present study that temperature has a decisive role in determining the seed quality characters. In view of the obtained results, it could be concluded that for obtaining the drip fertigation treatments such as T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11} and T_{12} significantly enhanced resultant seed quality parameters as compared to T_1, T_2, T_3 and control in both crops. Seed weight, seed germination, seedling length, dry matter production and vigour index could be taken as parameters for improving seed quality potential in kharif season.

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