Indian J. Dryland Agric. Res. & Dev. 2014 29(2) : 45-48 DOI 10.5958/2231-6701.2014.01214.7

Study of Different Moisture Stress Mitigation Techniques for *Rabi* Urdbean (*Vigna mungo* (L.) Hepper)

Ganajaxi Math, A.G. Vijayakumar, Yashoda Hegde and Kumari Basamma

AICRP on MULLaRP, University of Agricultural Sciences, Dharwad-580 005, Karnataka

Email: gkmathshreya@gmail.com

ABSTRACT: The experiment was conducted to find out appropriate moisture stress mitigation technique for *rabi* urdbean under rainfed conditions. The different moisture stress mitigation techniques *viz*., 2% KCl, 6% Kaolin, soil mulch, removal and incorporation of alternative rows, 2% KCl + 0.1% Boron, 2% Urea, 0.1% Nitrophosk (19:19:19 N:P:K), 0.1% Boron were tried along with absolute control and water spray. Among the different treatments, 2% KCl + 0.1% Boron spray at flowering and pod initiation stages recorded significantly higher grain yield (724 kg/ha) than other treatments (460-555 kg/ha) except 6% Kaolin (629kg/ha). Whereas gross returns (₹ 37898/ha), net returns (₹ 29138/ha) output/input (2.66) and energy use efficiency (81.35 kg/1000 MJ) were significantly higher in the treatment 2% KCl + 0.1% Boron over others.

Key words: Moisture stress, mitigation techniques, net returns, output-input energy and energy use efficiency

Pulses are grown under residual moisture in paddy fallows. The availability of moisture gradually reduces as plant grows and there will be terminal moisture stress at flowering stage. It reduces the yield of pulses to the tune of 20-30%. Potassium and Chlorine play an important role in osmoregulation of plants, experimental evidence from chickpea suggests beneficial effects of K application under soil moisture deficit (Singh *et al.,* 1997). In addition, most importantly, under moisture stress conditions chloroplasts lose high amounts of K and further depress the photosynthesis (Sen Gupta and Berkowitz, 1987). This discussion strongly supports the idea that increase in severity of moisture stress results in corresponding increase in K demand to maintain photosynthesis and protect chloroplasts from oxidative damage. In view of these results, it can be concluded that improvement in K nutritional status of plants seems to be of great importance for sustaining high yields under rainfed conditions. Boron is also important for the growth of reproductive part in plants. Boron improves the moisture stress tolerance in plants by improving sugar transport, flower retention, pollen formation and seed germination. Seed and grain production are also increased with proper B supply (Waraich, 2011). Blackgram (*Vigna radiata*) is an important pulse crop raised in paddy fallows spread over one lakh ha area in Karnataka. Often, blackgram experiences terminal moisture stress under residual moisture of paddy fallows. Hence this study was conducted to compare KCl and Boron application with other foliar sprays of nutrients, soil mulch and reduced population *etc.* and to find out productive, profitable and energetically efficient moisture stress mitigation techniques for *rabi* urdbean.

Material and Methods

The experiment was conducted at main agricultural research station, University of Agricultural Sciences, Dharwad during *rabi,* 2008-09 and 2009-10 under rainfed condition. The geographical co-ordinates of Dharwad are 15° 26' N latitude and 75° 7' E longitude and an altitude of 678 m above mean sea level. It is located in the Northern Transition Zone (Zone-8) of Karnataka. The soil of the experimental site was clayey in nature and having available N, P and K of 208, 12.6 and 270 kg/ha, respectively. Organic carbon and pH of the soil were respectively 0.52% and 7.2. The different moisture stress mitigation techniques *viz.,* 2% KCl, 6% Kaolin, soil mulch, removal and incorporation of alternative rows, 2% KCl + 0.1% Boron, 2% Urea, 0.1% Nitrophosk, 0.1% Boron were tried along with water spray and absolute control. Sprays were given at 40 and 55 DAS and removal incorporation of plants was perfomed at 40 DAS. The experiment was laid out in Randomized Block Design. Urdbean genotype LBG-685 was sown on 20th and 25th October of 2008 and 2009, respectively. Recommended dose of 25 and 50 kg/ha of N and P_2O_5, respectively applied uniformly to all the treatments at the time of sowing. Energy budgeting was done according to Mittal *et al.* (1985). Energy equivalents for men labour (1.98 MJ), woman labour (1.57 MJ), Bullock pair (14.05 MJ) seed (14.7 MJ/kg), N (60.6 MJ/kg), P_2O_5 (11.1 MJ/kg), K_2O (6.7 MJ/kg), plant protection chemicals (120 MJ/kg) and haulm (10 MJ/kg) were used for calculating output and input energy (1000 MJ/ha) and energy use efficiency was calculated as suggested by Padhi (2001).

Results and Discussion

Yield and yield attributes

Among the different treatments, 2% KCl + 0.1% Boron spray at flowering and pod initiation stages recorded significantly higher grain yield (724 kg/ha) than other treatments (460-555 kg/ha) except 6% Kaolin (629 kg/ha).Number of pods/plant (25.76 and 21.20, respectively) and 100 seed weight (5.77 and 5.28g, respectively) were also on par in the treatments 2% KCl + 0.1% Boron and 6% Kaolin (Table 1). These two treatments recorded respectively 57.4 and 36.7% higher yield over control and other treatments were on par with the control. This indicated the significant reduction in yield due to moisture stress and was compensated by 2% KCl + 0.1% Boron spray. Alleviation of detrimental effects of moisture stress, especially on photosynthesis, by sufficient K supply has been observed in legumes by Sangakkara *et al.* (2000). However, in the present study combination of K and Boron performed better than their

Table 1 : Yield and yield parameters of blackgram as influenced by different moisture stress mitigation techniques

Treatments	Seed yield (kg/ha)			Number of branches/plant			Number of pods/plant			100 seed weight (g)		
	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled
Absolute control	422	459	460	3.13	3.33	3.23	13.30	14.10	13.70	5.02	5.18	5.10
Water spray	458	502	480	3.27	3.00	3.13	13.00	14.26	13.63	5.10	5.14	5.12
2% KCl	519	592	555	3.40	3.60	3.50	18.60	17.40	18.00	5.18	5.26	5.22
6% Kaolin	600	657	629	3.40	3.53	3.46	22.60	20.86	21.20	5.22	5.34	5.28
Soil mulch	505	490	497	4.00	3.93	3.96	16.60	16.33	16.46	5.28	5.23	5.26
Removal & incorp.	609	398	503	4.13	3.86	3.99	21.60	22.60	22.10	5.30	5.42	5.36
2% KCl + 0.1% Boron	769	679	724	4.67	3.80	4.23	26.80	24.73	25.76	5.74	5.80	5.77
2% Urea	498	602	550	3.40	3.86	3.63	20.00	18.00	19.00	5.25	5.33	5.29
0.1% Nitrophosk	545	539	542	3.20	4.13	3.66	18.60	16.50	17.55	5.21	5.35	5.28
0.1% Boron	499	557	528	3.27	3.40	3.33	15.00	17.00	16.00	5.07	5.43	5.25
SEm±	57	35	46	0.12	0.23	0.17	1.47	1.85	1.68	0.14	0.23	0.17
CD (P=0.05)	171	104	138	0.36	0.60	0.51	4.38	5.51	4.96	0.41	NS	0.50

individual application. Due to removal and incorporation of alternative rows (T_6), there was increase in pod number/plant and 100 seed weight which were not associated with concomitant increase in yield which might be attributed to reduction in population (up to 50%). Due to wider spacing available to each plant, there was reduction in competition for moisture and other resources and it enhanced the number of pods/plant and 100 seed weight. Even then it was unable to compensate the 50% population with regard to yield.

Economic analysis

Per ha gross returns and net returns accrued (Table 2) were significantly higher in the treatment 2% KCl + 0.1% Boron spray (T_7) at flowering and pod initiation stages (₹ 37,898, ₹ 29,138, respectively) compared to others. Total cost of cultivation incurred per ha of T_7 was also not high (₹ 8760) compared to other treatments (₹ 8550 to 9500). It recorded 19.9% higher net returns over T_4 treatment (6% Kaolin) and 114.6% over control. This was attributed to efficient use of water under moisture scarcity and recorded higher grain yield due to proper development of pods, which was indicated by significantly higher number of pods/plant (25.76) and 100 seed weight (5.77g) in 2% KCl + 0.1% Boron compared to others (Table 1). Chandrasekhar and Bangaraswamy (2003) recorded higher net returns when crop was sprayed with DAP (2%) + 1% KCl + NAA 40 ppm compared to other treatments and so on. The B:C ratio was also significantly higher in the treatment 2% KCl + 0.1% Boron (4.33) compared to control (2.59), soil mulch (2.92) and removal and incorporation of alternative rows (2.98) and on par with other treatments (3.12-3.77).

Energy budgeting

Pooled data indicated that though the treatments T_7 (2% KCl + 0.1% Boron) and T_4 (6% kaolin) were on par with regard to total output (23.67 x 1000 MJ/ha and 20.57 x 1000 MJ/ha), respectively and net output energy (14.77 x 1000 MJ/ha and 11.35 x 1000 MJ/ha), respectively (Table 3). While T_7 (2.66 and 81.35 kg/1000 MJ) was significantly superior over T_4 (2.33 and 68.32 kg/1000 MJ), respectively in terms of output/input ratio and energy use efficiency due to lower input energy (8.90 x 1000 MJ/ha) and higher yield (724 kg/ha) obtained in former compared to latter (9.2 x 1000 MJ/ha and 629 kg/ha), respectively.

Conclusion

It can be concluded from the results of this study that spraying of 2% KCl + 0.1% Boron at flowering and pod initiation is useful for *rabi* urdbean under rainfed condition to mitigate moisture stress.

Table 2 : Economics of blackgram as influenced by different moisture stress mitigation techniques

Treatments	Total cost of cultivation			Gross returns (₹/ha)			Net returns (₹/ha)			B-C ratio		
	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled
Absolute control	8500	8600	8550	20100	24145	22123	11600	15545	13573	2.36	2.81	2.59
Water spray	8600	8700	8650	22900	27610	25255	14300	18910	16605	2.66	3.17	2.92
2% KCl	8700	8800	8750	25950	32560	29255	17250	23760	20505	2.98	3.70	3.34
6% Kaolin	8720	8820	8770	30000	36135	33068	21280	27315	24298	3.44	4.10	3.77
Soil mulch	9000	10000	9500	25250	26950	26100	16250	16950	16600	2.81	2.70	2.75
Removal & incorp.	8740	8840	8790	30450	21890	26170	21710	13050	17380	3.48	2.48	2.98
2% KCl + 0.1% Boron	8710	8810	8760	38450	37345	37898	29740	28535	29138	4.41	4.24	4.33
2% Urea	8700	8800	8750	24900	33110	29005	16200	24310	20255	2.86	3.76	3.31
0.1% Nitrophosk	8800	8900	8850	27250	29645	28448	18450	20745	19598	3.10	3.33	3.21
0.1% Boron	8850	8950	8900	24950	30635	27793	16100	21685	18893	2.82	3.42	3.12
SEm±				938	1240	1120	938	1240	1120	0.30	0.59	0.42
CD (P=0.05)				2758	3646	3293	2758	3646	3293	0.99	1.77	1.26

Table 3 : Energy budgeting of blackgram as influenced by different moisture stress mitigation techniques

Treatments	Input (1000 MJ)	Total output energy (1000 MJ/ha)			Net output energy (1000 MJ/ha)			Output/Input			Energy use efficiency (kg/1000 MJ)		
		2008-09	2009-10	Pooled	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled	2008-09	2009-10	Pooled
Absolute control	8.71	13.80	15.01	15.04	5.09	6.30	5.69	1.58	1.72	1.65	48.45	52.70	50.57
Water spray	8.72	14.98	16.42	15.70	6.26	7.70	6.98	1.72	1.88	1.80	52.52	57.57	55.05
2% KCl	8.78	16.97	19.36	18.15	8.19	10.58	9.38	1.93	2.20	2.07	59.11	67.43	63.27
6% Kaolin	9.20	19.62	21.48	20.57	10.42	12.28	11.35	2.13	2.34	2.23	65.22	71.41	68.32
Soil mulch	8.77	16.51	16.02	16.25	7.74	7.25	7.50	1.88	1.83	1.85	57.58	55.87	56.73
Removal & incorp.	8.72	19.91	13.01	16.45	11.19	4.29	7.74	2.28	1.49	1.89	69.84	45.64	57.74
2% KCl + 0.1% Boron	8.90	25.15	22.20	23.67	16.25	13.30	14.77	2.83	2.49	2.66	86.40	76.29	81.35
2% Urea	9.30	16.28	19.69	17.99	6.98	10.39	8.69	1.75	2.12	1.93	53.55	64.73	59.14
0.1% Nitrophosk	8.73	17.82	17.63	17.72	9.09	8.90	8.99	2.04	2.02	2.03	62.43	61.74	62.08
0.1% Boron	8.73	16.32	18.21	17.27	7.59	9.48	8.54	1.87	2.09	1.98	57.16	63.80	60.48
SEm±		1.20	0.80	0.90	1.20	0.80	0.90	0.20	0.30	0.10	3.20	4.20	3.50
CD (P=0.05)		3.60	2.40	2.70	3.60	2.40	2.70	0.60	0.90	0.30	9.60	12.60	10.50

References

Chandrashekar CN and Bangaraswamy U. 2003. Maximizing the yield of mungbean by foliar application of growth regulating chemicals and nutrients. Madras Agricultural Journal 90 (1-3): 142-145.

Gomez KA and Gomez AA. 1984. Statistical Procedures for Agricultural Research. 2nd edn. John Willey and Sons, New York.

Mittal VK, Mittal JP and Dhawan KC. 1985. Research digest on energy requirements in Agricultural Section. *(in)* Energy Requirement Scheme Report, ICAR New Delhi.

Padhi AK. 2001. Effect of vegetable intercropping on productivity, economics and energetics of maize (*Zea mays*). Indian Journal of Agronomy 46: 204-210.

Sangakkara UR, Frehner M and Nosberger J. 2000. Effect of soil moisture and potassium fertilizer on shoot water potential, photosynthesis and partitioning of carbon in mungbean and cowpea. Journal of Agronomy and Crop Science 185**:** 201-207.

Sen Gupt A and Berkowitz GA. 1987. Osmotic adjustment, symplast volume, and non-stomatally mediated water stress inhibition of photosynthesis in wheat. Plant Physiology 85: 1040-1047.

Singh N, Chhokar V, Sharma KD and Kuhad MS. 1997. Effect of potassium on water relations, CO_2 exchange and plant growth under quantified water stress in chickpea. Indian Journal of Plant Physiology 12(3): 202-206.

Waraich EA, Rashid Ahmad, Saifullah MY and Ashraf E. 2011. Role of mineral nutrition in alleviation of moisture stress in plants. Australian Journal of crop science 5(6): 764-777.

Received: April 2014; Accepted: December 2014