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IMPACT OF EARLY SOWING ON PROTEIN CONTENTS AND NITRATE REDUCTASE ACTIVITY IN BLACK GRAM UNDER SALT STRESS

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ABSTRACT

Reduction in protein contents and NRA was found in two black gram cultivars (salt sensitive IP- 98/120 and salt resistant IP-98/126) under induced salinity and sodality regimes. This reduction was considerably higher in susceptible cultivar than tolerant one. Salinity proved relatively more detrimental. Early sowing caused decrement in protein contents and NRA more pronounced at all stages of growth.

Key words: Protein, NRA, Early sowing, late sowing, salt regime.

Crop production is, more often, severely hindered by various abiotic stress encountered by plants in the field which disturb numerous biochemical and physiological facets in plants. Grain legumes interchangeably referred as pulses owe a strategic position in agricultural economy of the Indian subcontinent, being the major source of protein of the vegetarian country. Salt regimes *viz*. , salinity and sodicity adversely affect various facets of plant metabolism (Ramamoorthy, 1968 ; Varshney and Baijal, 1977 ; Singh *et al*. , 1994). Salt stress is known to reduce the synthesis of proteins (Prisco *et al.,* 1975 ; Malakondaiah and Rao, 1979 ; Reddy and Vora, 1985). The activity of nitrate reductase (E.C. 1.6.6.1), a key enzyme of nitrate assimilation, is regulated by a number of nutritional and environmental factor and co-related with N-status of plant (Mishra and Srivastava , 1983). The activity of NR enzyme decline considerably with an increase in salt concentration (Plaut,1974 ; Austenfield,1974 ; Lal and Bhardwaj, 1987 ; Sekhon *et al*., 1987 ; Burman *et al*., 2001 ; Rathor, 2006).

In the present investigation , impact of early sowing has been done on protein contents and NRA in black gram under salt stressed conditions. Saxena and Yadav, (1976) ; Dahiya *et al*., (1988) have reported that the seeding date has a profound effect on the growth and yield of various grain and legume crops.

METHODOLOGY

Certified 0.1% (w/v) $HgCl_2$ sterilized viable seeds of two cultivars of black gram *viz*., IP-98/120 and IP-98/126 after inoculation with *Rhizobium* were sown in equal 1 M^2 area plots floored by a polythene sheet at a depth of 40cm containing a mixture of soil and compost (3:1).

The beds were made saline and sodic using NaCl and Na_2CO_3 respectively following Richard's formula to maintain salt regime of 4 and 8 $mScm^{-1}$.Tap water was used to maintain a set of control. The degree of salt regimes was cross examined by using direct reading conductivity meter.

The seeds were sown twice on seed beds. Once on proper sowing time (1^{st} week of April) and once one month early (1^{st} week of March). Protein estimation was done by using the method of Snell and Snell (1955) for total nitrogen and multiplying the data with 6.25 factor. NRA was estimated using the method of Klepper *et al.*, (1971).The value for both parameters were taken thrice for early and normal sowing.

RESULTS AND DISCUSSION

When the seeds are sown at proper time, the protein contents of both the cultivars of black

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gram plants revealed decreasing trend with increasing salt regimes. The protein contents kept on increasing with the progressive stages of life cycle (Table 1 and 2).When the seeds are sown one month early, the same reducing trend of protein contents was observed. The protein contents were reduced further in addition to the loss caused due to salt regime in case of early sowing. Greater amount of proteins were noticed in tolerant cultivar (IP-98/126) than susceptible one in both the cases *viz*., early sowing and well in time sowing.

Data given in Tables 3 and 4, demonstrate inhibition of NRA by induction of both salinity and sodicity at various stages of growth and development investigated which decreased further on increasing exposure to salt regimes. The NRA reduced with progressive stages of life cycle. The tolerant cultivar revealed higher values of NRA under all degrees of imposed salt regimes than susceptible cultivar. Salinity seemed to be more harmful for protein contents and NRA in well in time sowing and early sowing conditions in comparison of sodicity.

Table 1: Effect of early sowing on protein contents (mg/gm) in two cultivars of black gram under salinity (NaCl) stress (values are the means of three replicates).

Black gram Cultivars	Sowing	Treatments ($mScm^{-1}$)	Growth stages		
			Flagging	Panicle Development	Grain Development
IP-98/120	Well in time	1.2(C)	111.25	116.00	125.75
		4	106.25	110.00	117.75
		8	95.00	97.00	103.75
	1 month early	1.2(C)	98.36	102.20	110.36
		4	92.58	83.56	115.78
		8	80.23	52.00	49.00
IP-98/126	Well in time	1.2(C)	126.75	132.25	141.25
		4	122.75	127.25	134.25
		8	114.75	116.25	122.25
	1 month early	1.2(C)	130.56*	102.15	112.50
		4	99.36	100.37	93.27
		8	85.30	57.20	72.25

Data insignificant

Table 2: Effect of early sowing on protein contents (mg/gm) in two cultivars of black gram under sodicity (Na_2CO_3) stress (values are the means of three replicates).

Black gram Cultivars	Sowing	Treatments ($mScm^{-1}$)	Growth stages		
			Flagging	Panicle Development	Grain Development
IP-98/120	Well in time	1.2(C)	111.25	116.00	125.75
		4	108.25	112.00	119.75
		8	101.00	104.00	109.75
	1 month early	1.2(C)	99.56	105.39	115.56

		4	91.32	87.36	112.25
		8	83.26	58.72	76.00
IP-98/126	Well in time	1.2(C)	126.75	132.25	141.25
		4	124.75	129.25	137.25
		8	119.50	123.25	129.25
	1 month early	1.2(C)	130.56*	106.36	117.86
		4	99.36	90.25	101.25
		8	85.30	73.63	10.36*

***Data insignificant**

Table 3: Effect of early sowing on nitrate reductase activity (µmol NO_2 h^{-1} g^{-1} fr.wt.) in two cultivars of black gram under salinity (NaCl) stress (values are the means of three replicates).

Black gram Cultivars	Sowing	Treatments ($mScm^{-1}$)	Growth stages		
			Flagging	Panicle Development	Grain Development
IP-98/120	Well in time	1.2(C)	5.40	5.12	4.84
		4	4.65	4.10	3.52
		8	4.15	3.56	3.01
	1 month early	1.2(C)	5.24	4.83	4.00
		4	5.56	3.96	3.00
		8	3.99	3.24	2.76
IP-98/126	Well in time	1.2(C)	5.65	5.50	5.39
		4	5.1	4.72	4.36
		8	4.63	4.26	3.99
	1 month early	1.2(C)	5.38	5.1	5.00
		4	5.3	5.1	4.13
		8	4.01	4.03	2.00

***Data insignificant**

Table 4: Effect of early sowing on nitrate reductase activity (µmol NO_2 h^{-1} g^{-1} fr.wt.) in two cultivars of black gram under sodicity (Na_2CO_3) stress (values are the means of three replicates).

Black gram Cultivars	Sowing	Treatments ($mScm^{-1}$)	Growth stages		
			Flagging	Panicle Development	Grain Development
IP-98/120	Well in time	1.2(C)	5.40	5.12	4.84
		4	4.80	4.10	3.52
		8	4.30	3.56	3.01

	1 month early	1.2(C)	5.60*	4.83	4.00
		4	4.63	3.96	3.00
		8	4.00	3.24	2.76
IP-98/126	Well in time	1.2(C)	5.65	5.50	5.39
		4	5.15	4.88	4.41
		8	4.69	4.56	4.19
	1 month early	1.2(C)	5.10	5.00	4.80
		4	5.00	4.23	4.10
		8	5.56*	4.01	3.00

***Data insignificant**

The decrement in protein contents may be caused due to enhanced protease activity (Sheoran and Garg, 1978) or due to hydrolysis of proteins (Uprety & Sarin, 1975).The dose dependent inhibition in nitrate reductase activity (NRA) may be caused due to dissociation of FAD in the leaves (Safarliev *et al*., 1984) ; due to shortage in the supply of electron donors NADH/NADPH (Gengenbach *et al*., 1973) or due to reduced supply of substrate to active site of enzymes resulting from inhibition of nitrate uptake i.e. depletion of endogenous nitrate pool (Trogisch *et al.*, 1989). Further reduced values of protein contents and NRA in case of early sowing may be attributed to reduction in pre and post flowering periods (Eschel, 1988).

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