Indian J. Plant Physiol., Vol. 11, No. 2, (N.S.) pp. 209-212 (April-June, 2006)

SHORT COMMUNICATION

PROTECTION OF GROUNDNUT PLANTS FROM WATER STRESS BY CHLORFLURENOL AND CYCOCEL

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Received on 25 Oct., 2005, Revised on 20 April, 2006

Presoaking of Groundnut seeds (*Arachis hypogaea* L.) in solutions of chlorflurenol (CFL) and cycocel (CCC) resulted in higher yield under drought conditions. Studies on drought indices like relative water content (RWC), proline accumulation and transpiration supported the antitranspirant action of these chemicals.

Key words: **CCC, chlorflurenol, groundnut.**

Plant responses to drought stress are manipulated by changes in physiological and metabolical processes (Tabaizadeh 1998). Though genetic manipulations and adaptation to natural conditions have certain advantages, the complex traits of stress phenomena make these steps less effective (Wang *et al*. 2003). Plant growth regulators (PGRs) modulate plant response to unfavourable environment (Dallmier and Stewart 1992, Manju *et al.* 2001). Chlorflurenol (CFL) and Cycocel (CCC) are grouped as inhibitors of gibberellin biosynthesis. There are, however, reports of growth promotion by CFL in cucumber (Nerson-Hairn1998) and mangoes (Gonzalez *et al*. 2004). Yield-promotion by CCC in groundnut (Singh and Rathore 1987) and anti transpirant action in brinjal (Prakash and Ramachandran 2000) have been reported. In the present study, the effect of synthetic PGRs chlorflurenol (CFL) and cycocel (CCC) were tested on groundnut variety TAG 24 for yield as well as drought indices like relative water content(RWC), proline content and transpiration under drought conditions.

Seeds of Trombay groundnut variety TAG24 were soaked in solutions of CFL and CCC (both 10^{-6}M) for 6h, and sown in experimental field of BARC at Trombay, Mumabi. One month old plants were given regulated water supply of once in 4 days (4d), 7 days (7d) or 10 days (10d). The controls were not treated with PGRs but were grown under same water regimes. The distance between plants was 10cm and between rows 30cm in a total area of $50m^2$. The experiment was conducted in the rabi seasons (Jan.-April) of 2003 and 2005. The plants were harvested at maturity and various parameters related to growth and yield were recorded. For determination of relative water content (RWC) and proline, seeds were soaked in water and solutions of CFL and CCC for 6h and grown in sand. Three weeks old plants were transferred to nutrient solution containing PEG 6000 at concentrations of 200, 250 or 300g/l giving osmotic potentials of –0.85,-1.3 and –1.8 Mpa respectively (Michael and Kaufman 1973), for varying durations of 6, 15 or 24h. Uniform sized (3mm diameter) leaf discs were taken for measuring RWC. After recording the fresh weights, the discs were floated on deionized water for 2h and the turgid weights and dry weights were taken.

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RWC=Fresh wt-Dry wt ÷ Turgid wt.- Dry wt x 100.

Proline was estimated in the leaf discs according to the method of Troll and Lindsley (1955). Net water loss was calculated per plant as well as per unit leaf area. Leaf area was measured by using digital images of leaves obtained by scanner. Least significant difference (LSD) was calculated according to Snedecor and Cochran(1968). Values with 5% error margin were taken as significant. For transpiration studies Student't' test was performed.

The decrease in plant dry weight and pod weight due to water stress was more in controls as compared to PGR treated plants (Table 1). CFL and CCC treated plants showed higher harvest index as compared to untreated plants. This may be by preventing the stress induced early maturity of the pods as both these chemicals are known to be inhibitors of vegetative growth. Studies on relative water content showed that after 6 and 15h of PEG treatments both CFL and CCC had significantly higher RWC compared to control (LSD> 5.02 and 5.27) (Table 2). However, they were not able to come to the level of '0'h controls and hence as in case of plant and pod weight, the recovery in PEG induced inhibition of RWC was also partial. Such partial recovery in RWC by CCC was also reported by Mathur *et al*. (2005). Since CFL and CCC treatments slowed the growth, the resultant reduction in leaf area may have helped in reducing the water loss and keeping RWC at a higher level. Another important observation was that it was the duration of PEG treatment that mattered more than the concentration (Table 2).

PEG treatment increased proline level in controls as well as in PGR treated samples (Table2). In control samples the increase was around 4 times at 6h, 10times at 15h and 60 times at 24h compared to the 0 h value. As is evident from Table 2, at low stress levels significant increase in proline levels (>4.68 LSD) in case of CCC treatment could be seen. In CFL treatment also the trend was stimulatory, but statistically not significant. At higher stress levels the proline level went up, but the difference between treatments was not significant. This suggests a probable interference by the PGRs at low stress levels while no such effect is seen at higher stress levels. Proline can be considered as a storage compound supplying reductants, reduced nitrogen and carbon skeleton for post stress recovery (Venecamp 1989). However, its contribution to osmotic adjustment and tolerence of plants exposed to unfavourable conditions is still controversial (Hare and Cress1987, Azooz *et al.* 2004). Transpiration studies showed a reduction in water loss per plant in CFL treatments. However, on unit leaf area basis no difference

Table 1. Effect of synthetic plant growth regulators chlorflurenol (CFL) and cycocel (CCC) on yield parameters at different water regimes in groundnut var. TAG 24.

Parameters	Frequency of water supply (days)	Control	CFL	CCC	LSD (df 63) at 0.05P
Dry wt (g) plant^{-1}	4	76	63	72	
	7	56	65	48	10.84
	10	30	44	40	
Pod wt.(g) plant^{-1}	4	36	26	34	
	7	15	27	12	6.39
	10	5	11	12	
Harvest Index (%)	4	43	55	47	
	7	27	40	26	
	10	13	25	30	

Table 2. Effect of synthetic plant growth regulators chlorflurenol (CFL) and cycocel (CCC) on RWC expressed as (%) and proline content expressed as (μmol g^{-1}fw) in groundnut var. TAG 24.

Duration of PEG treatments	PEG g/l	PGR treatments						LSD	
		Control		CFL		CCC			
		RWC	Proline	RWC	Proline	RWC	Proline	RWC	Proline
6h	0	87	3.8	87	3.8	87	3.8		
	200	52	14.7	62	18.0	64	21		
	250	55	12.5	61	15.8	57	24.3	5.02	4.68
	300	50	14	62	15.5	60	27.3		
15h	0	87	3.8	87	3.8	87	3.8		
	200	54	35.3	62	42.8	63	39.2		
	250	54	44.8	59	39.1	63	37.6	5.27	9.40
	300	55	51.4	61	46.4	63	44.8		
24h	0	87	3.8	87	3.8	87	3.8		
	200	44	204	56	188	50	134		
	250	44	268	51	179	48	146	5.52	95.90
	300	48	237	48	180	48	193		

could be observed (Table 3). CFL treated plants had reduced leaf area and proportionately less transpiration.

Productivity loss due to drought is partially recovered by pretreatment of seeds with chlorflurenol and CCC. Similar trend was observed in case of RWC and proline. Though transpiration per plant is reduced by CFL, there is no difference per unit leaf area. Water stress experienced by crops during growth has cumulative effects on various growth and metabolic parameters, which are ultimately expressed as reduction in final biomass production below unstressed potential. Both CFL and CCC are able to counter the drought effects partially and improve yield under such conditions. As these synthetic plant growth regulators are known to inhibit gibberellin biosynthesis, slowing down of the growth processes may be responsible for their antitranspirant effect. Reduced rate of transpiration may result in drought tolerance displayed by CFL treated plants. The exact mechanism of action remains to be discerned.

Table 3. Effect of chlorflurenol (CFL) and cycocel (CCC) on net water loss in groundnut var. TAG 24.

Treatments	Total leaf area (cm^2 $plant^{-1}$)	Water loss $plant^{-1}$	Water loss cm^{-2} leaf area
Water	47.9 ± 1.71	45.5 ± 1.59	0.95 ± 0 .050
CFL	38.2*± 2.05	36.3* ± 2.18	0.95 ± 0 .030
CCC	53.6 ± 5.11	48.8 ± 7.03	0.91 ± 0.041

*p<0.05(n=4); All values are Mean ± SE

ACKNOWLEDGEMENTS

Authors are thankful to Dr.G.S.S.Murthy and experimental field staff for their help in field experiments. Critical evaluation of the manuscript by Dr.(Mrs.) J.K.Sainis is highly appreciated.

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