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EFFECT OF WATERLOGGING AND GIBBERELLIC ACID ON GROWTH AND YIELD OF PEANUT (*ARACHIS HYPOGAEA* L.)

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SUMMARY

Plants of peanut (*Arachis hypogaea* L.) were waterlogged for 7 and 14 days at vegetative, flowering and pod-filling stages and were treated with 10 and 100 mg^{-1} of gibberellic acid (GA_3). Waterlogging decreased the shoot height at all the stages and the root shoot ratio only at pod-filling stage. Further it also adversely affected the yield parameters and significantly decreased the number of flowers and pods, pod weight and seed weight. Its effect at pod-filling stage was more deleterious than at other stages. Both 10 and 100 mg^{-1} of GA_3 increased all the yield parameters.

The deleterious effects of waterlogging on various growth and yield parameters were partially alleviated by exogenous application of GA_3.

INTRODUCTION

Waterlogging is reported to decrease growth and yield of legume crops (Cannell *et al.*, 1979). The extent of injury due to waterlogging depends upon the genotype, environmental conditions, stage of development and the duration of stress (Orchard and Jessop, 1984: Choi *et al.*, 1986). Waterlogging reduces root and shoot growth, dry matter accumulation and the final crop yield (Minchin *et al.*, 1977; Scott *et al.*, 1989). The deleterious effects of stress are due to anaerobic conditions and impaired respiratory metabolism with the resultant inhibition of water and mineral uptake and deranged hormonal metabolism (Hiron and Wright, 1973; Pradet and Bomsel, 1978; Orchard *et al.*, 1985). While the synthesis of gibberellin and cytokinin in the root is reduced (Burrows and Carr, 1969) that of ABA and ethylene is increased (Hiron and Wright, 1973). Therefore, some of the waterlogging symptoms may be partly because of deficiency of endogenous GA and cytokinins (Jackson and Campbell, 1979).

MATERIALS AND METHODS

Plants of peanut (*Arachis hypogaea* L.) cv. MH-2 raised in polythene bags were subjected to 7 and 14 days of waterlogging as described elsewhere (Bishnoi and Krishnamoorthy, 1993). Soon after the relieval of stress, these were sprayed with 10 and 100 mg^{-1} of acqueous solution of GA_3 to run off and water sprayed plants served as control. Plants received waterlogging and GA_3 treatment at 35, 50 and 80 days after sowing corresponding to vegetative, flowering and pod-filling stages, respectively. There were 18 plants in each treatment out of which six uniform plants were selected and labelled for recording the total number of flowers produced. At the time of harvest, growth data, the number and weight of pods and seeds produced were also recorded separately from these plants.

RESULTS AND DISCUSSION

Waterlogging significantly reduced the shoot height, and the effect being more with increase in duration of stress at all the stages (Table I). The deleterious effect of stress was more marked at flowering followed by at vegetative and pod-filling stages. Application of GA_3 significantly increased the shoot height. Both 10 and 100 mg^{-1} of GA_3 partially alleviated the deleterious effects of waterlogging.

Waterlogging regardless of the stage at which it was applied significantly decreased the total number of flowers produced (Table I) pod number, pod weight, seed weight and seed test weight (Table II). The decrease was more with 14 days of waterlogging as compared to 7 days. Waterlogging given at pod-filling stage was in general the most deleterious followed by at flowering and vegetative stages. These results are in agreement with already reported findings in cowpea (Minchin *et al.*, 1977), pea (Cannell *et al.*, 1979), peanut (Choi *et al.*, 1986) and soybean (Scott *et al.*, 1989). Such inhibition may be due to adverse effects of waterlogging on water and mineral uptake (Orchard *et al.*, 1985; Hocking *et al.*, 1987) and inhibition of synthesis and transport of photosynthetic assimilates and hormones (Burrows and Carr, 1969; Wample and Thornton, 1984).

Table I : Effect of waterlogging and GA_3 applied at different stages on growth and flowering of peanut cv. MH-2.

Stage	GA_3 (mg^{-1})	Plant height (cm) Waterlogging (days)			Root : Shoot Ratio Waterlogging (days)			Total number of flowers produced plant		
		0	7	14	0	7	14	0	7	14
Vegetative	0	66.2	53.3	46.2	0.26	0.28	0.28	45.8	39.3	33.2
	10	70.1	58.3	49.2	0.26	0.24	0.26	47.9	45.9	40.2
	100	71.2	57.2	50.1	0.23	0.21	0.22	53.7	48.5	43.5
C.D. at 5% P			2.5						2.3	
Flowering	0	66.2	56.1	49.2	0.26	0.28	0.34	45.8	30.5	23.2
	10	60.1	61.2	53.1	0.24	0.25	0.29	49.2	36.0	29.6
	100	70.8	62.1	53.6	0.23	0.16	0.28	52.3	37.8	32.6
C.D. at 5% P			2.9						2.1	
Pod-filling	0	66.2	63.0	60.4	0.26	0.25	0.18	45.8	36.8	30.2
	10	66.7	64.4	61.2	0.25	0.25	0.22	45.0	42.1	30.0
	100	67.1	65.1	62.0	0.25	0.22	0.19	46.1	41.3	33.4
C.D. at 5% P			1.1						1.3	

Table II : Effect of waterlogging and GA_3 applied at different stages on growth and yield of peanut cv. MH-2.

Stage	GA_3 (mg^{-1})	Pod number $plant^{-1}$ Waterlogging (days)			Pod weight (g $plant^{-1}$) Waterlogging (days)			Seed weight (g $plant^{-1}$)			100-seed weight (g)		
		0	7	14	0	7	14	0	7	14	0	7	14
Vegetative	0	12.2	9.6	8.1	7.08	4.96	3.76	4.68	3.17	2.44	31.77	26.31	24.18
	10	13.9	10.2	9.7	7.18	5.39	3.87	4.48	3.66	2.67	27.23	28.85	26.31
	100	15.1	12.4	9.9	7.42	6.63	4.17	5.19	4.77	3.09	29.43	26.70	25.19
C.D. at 5% P			0.5			0.19			0.25			1.81	
Flowering	0	12.2	7.4	6.8	7.08	4.03	2.62	4.68	2.54	1.71	31.77	27.94	16.10
	10	13.0	8.8	8.3	7.13	4.94	3.35	4.78	3.21	2.25	25.92	32.12	17.81
	100	14.2	10.9	8.8	7.38	6.09	3.96	5.02	4.02	2.75	27.83	29.33	24.32
C.D. at 5% P			0.6			0.40			0.09			2.07	
Pod-filling	0	12.2	6.2	4.5	7.08	2.69	2.30	4.68	1.73	1.47	31.77	21.41	19.97
	10	12.8	7.7	5.2	7.22	3.69	2.36	4.69	2.44	1.48	22.71	23.18	20.50
	100	13.1	8.7	6.6	7.48	4.75	0.38	4.79	2.92	1.50	25.84	29.93	26.18
C.D. at 5% P			0.3			0.16			0.17			1.67	

Application of GA_3 significantly increased the number of flowers (Table I) and pods, pod weight and seed weight (Table II). The inhibitory effect of 7 days of waterlogging was completely alleviated by 100 mg^{-1} of GA_3 given at vegetative stage. However, the beneficial effect of GA_3 was partial when the duration of waterlogging was increased to 14 days. At other stages, both concentrations of GA_3 partially alleviated the deleterious effects of stress. Waterlogging is reported to cause GA deficiency in tomato by inhibiting its biosynthesis and transport (Reid adn Crozier, 1971). However, it is not known whether similar GA deficiency is caused by waterlogging in peanut as well. The relieval of deleterious effects of waterlogging by GA in peanut, however, points in this direction.

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