The Andhra Agric. J 56(3):360-363, 2009

Effect of Chemicals and Temperatures on Breaking Seed Dormancy in Kakrol (*Momordica dioica* Roxb.)

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ABSTRACT

The studies on the effect of different chemicals on breaking seed dormancy in kakrol seeds revealed that among the different chemicals and their concentrations, the seeds treated with GA_3 100 ppm gave early and higher percentage of germination, seedling length, seedling girth, vigour index and percentage of establishment in polythene bags. Between two temperatures, controlled temperature (30°C) recorded the higher percentage of germination (51.55), seedling length (14.87 cm), seedling girth (0.69 cm), vigour index (771.30) and percentage establishment in polythene bags (83.41).The interaction between chemicals x temperatures revealed that GA_3 100 ppm + controlled temperature (30°C) recorded early germination (11.44 days) and significantly higher percentage of germination (70.64), seedling length (16.50 cm), vigour index (1165.33) and percentage of establishment in polythene bags (93.33).

Key words : Chemicals, Kakrol,Seed dormancy

Kakrol is grown naturally in certain pockets of India but extensively in coastal belts of Andhra Pradesh (Trivedi and Roy, 1972). It grows naturally in bushes, along live fences and jungles. One of its wild relative is *Momordica cochinchinensis* Kakrol (*Momordica dioica* Roxb.) (2n = 2x = 28) is a cucurbitaceous, dioecious perennial (2n = 4x = 56) is characterized by larger leaves, flowers and fruits than *M. dioica* (Rashid, 1993). In India, it is one of the endangered and vulnerable species. Among them, *Momordica dioica* is the most important one. The fruit of *M. dioica* is nutritious and recognized as diuretic and laxative possessing vitamin C. Fruits are used against diabetes, malaria, allergy and inflammatory problems. Fruits are also used to cure ulcers, piles, sores and obstruction of liver and spleen. It also possesses several other medicinal properties and is good for those suffering from cough and digestive problems. The unripe fruits are sweet, oily and laxative. The seeds are used for chest problems and stimulate urinary discharge. The root contains a triterpenoid saponin which can be used as substitute for soap. It cures piles, migraine, excess sweating and cough.

The main problems confronting the cultivation of kakrol in different parts of the country are propagation, lack of production technology and post harvest technology for making it available throughout the year as it is highly seasonal and the post harvest losses at different stages of storage in kakrol fruits are reported to be 17.1 per cent (Bidyutdeka *et al.,* 2004).

Generally kakrol is propagated through seed, tuberous roots and semi hard wood cuttings of the vine. However, seed propagation poses problems like poor germination due to hard seed coat and long pre- bearing period. Moreover more than 50 per cent of seedlings may turn to male, which can be identified only after flowering.

MATERIAL AND METHODS

The present investigation was carried out at Agricultural Research Institute, ANGRAU, Rajendranagar, Hyderabad from June 2005 to November 2006. Temperatures were T_1 – Ambient temperature (22 ± 2°C) and T_2 – Controlled temperature (30°C). Chemicals used were :C_1 - Gibberellic acid 50 ppm, C_2 - Gibberellic acid 100 ppm, C_3 - Gibberellic acid 150 ppm, C_4 - KNO_3 1.5%, C_5 - KNO_3 2.0%,C_6 - KNO_3 2.5%, C_7 - Thiourea 0.75% C_8 - Thiourea 1.0%, C_9 - Thiourea 1.25%,C_{10} - NAA 150 ppm, C_{11}-NAA 200 ppm C_{12} - NAA250 ppm,C_{13} - Control (Hot water soaking). The number of seeds per treatment per replication were 50 and replicated 3 times under factorial CRD. The seeds were soaked in water overnight and again soaked in the chemical solution for two hours and shade dried. Seeds were sown in seed trays filled with vermiculite and kept under ambient temperature and controlled temperature (30°C). Observations recorded on percentage of germination, number of days taken for germination, seedling length, seedling girth, vigour index, percentage of establishment in polythenebags and subjected to statistical analysis as per Panse and Sukhatme (1967).

Table 1. Effect of different temperatures and chemicals on percentage of germination, number of days taken for initial germination and seedling length (cm) in kakrol seeds

Tempature/ Chemicals	Percentage of germination			Number of days taken for initial germination			Seedling length (cm)		
	Controlled Temperature (30⁰C)(T_1)	Ambient Temperature (22±2⁰C)(T_2)	Mean	Controlled Temperature (30⁰C)(T_1)	Ambient Temperature (22±2⁰C)(T_2)	Mean	Controlled Temperature (30⁰C)(T_1)	Ambient Temperature (22±2⁰C)(T_2)	Mean
C_1 Gibberellic acid 50 ppm	44.04	42.02	43.03	12.73	15.11	13.92	15.35	13.28	14.31
C_2 Gibberellic acid 100 ppm	70.64	52.67	61.66	11.44	12.80	12.12	16.50	15.23	15.86
C_3 Gibberellic acid 150 ppm	62.69	35.78	49.24	12.58	14.60	13.59	15.16	14.58	14.87
C_4 KNO_3 1.5%	48.09	41.55	44.82	13.04	13.32	13.18	12.63	12.21	12.42
C_5 KNO_3 2.0%	60.86	50.66	55.76	14.87	15.80	15.33	15.76	15.54	15.65
C_6 KNO_3 2.5%	57.87	46.47	52.17	13.37	14.67	14.02	15.39	15.15	15.27
C_7 Thiourea 0.75%	51.75	26.90	39.33	13.92	14.79	14.36	13.67	12.45	13.06
C_8 Thiourea 1.0%	61.32	33.09	47.21	13.91	14.51	14.21	12.79	12.03	12.41
C_9 Thiourea 1.25%	67.45	48.11	57.78	12.42	13.34	12.88	15.32	14.87	15.09
C_{10} NAA 150 ppm	34.81	16.80	25.80	13.92	16.17	15.05	16.34	15.49	15.92
C_{11} NAA 200 ppm	45.88	29.38	37.63	12.91	14.08	13.49	16.23	15.30	15.77
C_{12} NAA 250 ppm	43.67	42.57	43.12	15.97	16.64	16.30	15.70	13.63	14.66
C_{13} Control (Hot water soaking)	21.15	11.67	16.41	20.76	24.01	22.39	12.44	10.17	11.30
Mean	51.55	36.74		13.99	15.38		14.87	12.92	

	F-test	S.Ed	CD(0.05)	S.Ed	CD(0.05)	S.Ed	CD(0.05)
T(Temperatures)	*	0.330	0.670	0.139	0.281	0.047	0.092
C(Chemicals	*	0.869	1.710	0.366	0.718	0.119	0.092
T xC	*	1.230	2.418	0.518	1.015	0.169	0.331

* = Significant at 5% level of significance

Table 2.Effect of different temperatures and chemicals on seedling girth,vigour index and percentage of establishment in polythene bags in kakrol

Tempature/ Chemicals	Seedling girth			Vigour index			Percentage of establishment		
	Controlled Temperature (30⁰C)(T_1)	Ambient Temperature (22±2⁰C)(T_2)	Mean	Controlled Temperature (30⁰C)(T_1)	Ambient Temperature (22±2⁰C)(T_2)	Mean	Controlled Temperature (30⁰C)(T_1)	Ambient Temperature (22±2⁰C)(T_2)	Mean
C_1 Gibberellic acid 50 ppm	0.78	0.74	0.76	675.00	556.00	615.50	85.33	83.67	84.50
C_2 Gibberellic acid 100 ppm	0.82	0.79	0.80	1165.33	799.66	982.50	93.33	86.33	89.83
C_3 Gibberellic acid 150 ppm	0.73	0.71	0.72	950.33	520.33	735.33	91.33	86.66	89.00
C_4 KNO_3 1.5%	0.66	0.62	0.64	606.33	506.00	556.17	78.67	72.33	75.50
C_5 KNO_3 2.0%	0.71	0.70	0.71	936.00	784.67	860.34	88.00	82.00	85.00
C_6 KNO_3 2.5%	0.70	0.68	0.69	910.00	703.67	806.84	82.66	77.33	80.00
C_7 Thiourea 0.75%	0.65	0.65	0.65	706.66	334.33	520.50	82.00	79.00	80.50
C_8 Thiourea 1.0%	0.69	0.64	0.66	784.00	489.00	636.50	84.33	80.66	82.50
C_9 Thiourea 1.25%	0.65	0.62	0.63	1033.00	576.00	804.50	87.67	82.66	85.17
C_{10} NAA 150 ppm	0.72	0.67	0.70	568.33	273.00	420.67	82.00	79.66	80.83
C_{11} NAA 200 ppm	0.69	0.65	0.67	744.00	451.67	597.83	88.00	82.00	85.00
C_{12} NAA 250 ppm	0.65	0.63	0.64	685.33	578.00	631.67	82.00	80.00	81.00
C_{13} Control (Hot water soaking)	0.61	0.60	0.61	262.67	119.33	191.00	59.00	52.66	55.83
Mean	0.69	0.67		771.30	514.74		83.41	78.85	

	F-test	S.Ed	CD(0.05)	S.Ed	CD(0.05)	S.Ed	CD(0.05)
T(Temperatures)	*	0.003	0.007	5.206	10.20	0.305	0.599
C(Chemicals	*	0.008	0.017	13.272	26.01	0.779	1.526
T xC	*	0.012	0.024	18.770	36.71	1.102	2.159

* = Significant at 5% level of significance

RESULTS AND DISCUSSION

There are several instances, where different kinds of chemicals when applied exogenously to dormant seeds causing them to germinate. Some of these chemicals have potential value in agriculture and horticulture to accelerate germination or break the dormancy of seeds (Heydekcker and Coolbear,1977). Dormancy offers a set back to plant breeders who would like to grow plant generations in rapid succession. It also impedes seed testing work, as the results of planting value of seed cannot be assessed quickly incase of dormant seeds.

The significance of seed dormancy lies in the ability of the seed to overcome the unfavourable conditions so as to remain viable till the commencement of favourable environment. Seed dormancy is a state in which seeds fail to germinate even under favourable conditions of moisture, temperature and oxygen for germination (Wareing, 1963).

In the present investigation different chemicals such as GA_3, KNO_3, Thiourea and NAA at three different concentrations and at two temperature conditions were studied in kakrol on seed dormancy. The percentage of germination ranged from 16.41 with control to 61.66 with GA_3 100 ppm (Table 1). The number of days taken for initial germination ranged from 12.12 with GA_3 100 ppm to 22.39 with control (Table 1). The seedling length ranged from 11.30 cm with control to 15.86 cm with GA_3 100 ppm (Table 1). The seedling girth ranged from 0.61 cm with control to 0.80 cm with GA_3 100 ppm (Table 2). The vigour index ranged from 191.0 with control to 982.50 with GA_3 100 ppm (Table 2). The percentage of establishment in polythene bags ranged from 55.83 with control to 89.83 with GA_3 100 ppm (Table 2). Gibberellic acid at 100 ppm gave higher and early germination percentage, seedling length, seedling girth, vigour index and percentage of establishment followed by thiourea 1.25% and KNO_3 2%. This could be due to the effect of these chemicals in breaking seed dormancy. Similar results were also reported by Panchbhai *et al.* (2005) in spine gourd. The antagonism between growth promoters and naturally occurring germination inhibitors plays an important role in seed dormancy and the external application of gibberellin interacts with growth inhibitors in dormant seeds lowering the inhibitors concentration and facilitating germination by breaking seed dormancy at an early date .Therefore dormancy in kakrol seeds seems to be controlled by the balance between inhibitors and promoters. The exogenous application of gibberellic acid might have shifted the balance towards promoter side there by breaking the seed dormancy.

In the present investigation, GA_3 beyond 100 ppm and KNO_3 beyond 2.0% reduced the percentage of germination, seedling length, seedling girth, vigour index and percentage establishment of kakrol seedlings in polythene bags and also increased the number of days taken for initial germination. This might be due to toxic effect of the chemicals at higher concentrations. Further GA_3 at higher concentration (150 ppm) might have triggered alternative respiration on the day of inhibition irrespective of the incubation temperature. This might have triggered alternative respiration which may be detrimental for seed germination resulting in lower percentage of germination. Similar results were also reported by Ram Asrey *et al.* (2003) in muskmelon.

Temperature controls all plant process, among them germination is one. Different seeds have different temperature ranges within which they germinate. The precise sensitivity will vary according to the species. In the present experiment, the seeds incubated at 30^{o}C gave higher percentage of germination than at ambient temperature. Between two temperatures controlled temperature recorded higher percentage of germination (51.55), early germination (13.99 days), seedling length (14.87 cm), seedling girth (0.69 cm), vigour index (771.30) and percentage of establishment in polythene bags (83.41) than ambient temperature (36.74, 15.38, 12.92 cm, 0.67 cm, 514.74 and 78.85 respectively). This could be attributed to the possibility of leakage of amino acids or fluorescent material as a function of temperature. Hendricks and Taylerson, (1976) reported that leakage of such substances increased the permeability of plasmalemma at high temperatures. Devi and Selvaraj, (1994) reported that higher percentage of germination and vigour index at 25^{o}C and 95 per cent RH.

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(Received on 15.10.2008 and revised on 22.11.2008)