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Effect of foliar sprays of different chemicals on induction of seed dormancy in mungbean (*Vigna radiata* L.)

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Abstract
Mungbean is one of the important pulse crop in India. But this crop has instability in yield because of many reasons, one of this it is susceptible to pre-harvest sprouting which is major constraint to the expansion of mungbean production. There is need to induce short period of dormancy to minimize the yield losses. A present study was conducted for three years during *kharif* 2012, 2013 & 2014 at Seed Technology Research Unit, Dr. PDKV, Akola (MS) to induce short period of dormancy by using different chemicals. The mungbean crop var. AKM-8802 was sprayed with two foliar sprays of malic hydrazide (125, 250, 375 & 500 ppm), ascorbic acid (50, 100 & 150 ppm) and salicylic acid (100 & 200 ppm) at grain filling stage i.e. 50 days and 60 days after sowing. As per three years pooled data foliar sprays of maleic hydrazide @ 250 ppm showed significant result for number of pods /plant (22.43), seed yield (12.71 q/ha.), germination % and vigour index as well as beneficial in inducing seed dormancy up to 35 days due to metabolic changes taken place in the seed itself without adversely affecting the seed yield.

Keywords: Mungbean, seed dormancy, maleic hydrazide

Introduction
Mungbean (*Vigna radiata* L.) is one of the important pulse crops in India. Mungbean is grown widely for use as a human food (as dry beans or fresh sprouts), also can be used as a green manure crop and as forage for livestock. Since mungbean matures in about 60-70 days after sowing, it is an excellent crop for rotation in different cropping systems. Mungbean may also be sown as an intercrop or as a green manures or cover crop (Shanmugasundaram, 1991) [13]. This crop improves soil health by enriching nitrogen status, long term fertility and sustainability of the cropping systems. In India it is grown extensively in Madhya Pradesh, Maharashtra, Uttar Pradesh, Punjab, Andhra Pradesh, Karnataka and Tamil Nadu (Murugapriya *et al*., 2011) [11]. India is the largest producer and consumer of mungbean and it alone accounts for about 65% of the world acreage and 54% of the world production of this crop (Singh and Singh, 2011) [14]. In general, the pulse crops, gives lower yields than the cereal crops. There is instability in yield of pulses. Many reasons could be attributed for the low yield production of pulses. Pre-harvest sprouting is one of the most important factors for low yield of pulses. This is generally seen in almost all the pulses but most predominantly occur in the cultivar of mungbean. Mungbean is particularly susceptible to pre-harvest sprouting & this provides a major constraint to the expansion of mungbean production (Durga and Kumar, 1997) [4]. Many times rain at maturity cause pre-harvest sprouting in pod itself & results great losses. Sometimes, losses due to pre-harvest sprouting will be as high as 60-70% (Cheralu *et al*. 1999) [3]. Hence there is need to induce short period of dormancy to minimize the yield losses in mungbean. Therefore, the present study undertaken to induce the short period seed dormancy by using the chemical like maleic hydrazide (growth retardant & antiauxin), ascorbic acid (antioxidant) and salicylic acid (growth regulator). The introduction of antiauxin to the seed by means of foliar application at the time of seed development may suppress the auxin formation and induce dormancy (Leopold, 1958) [9].

Materials and Method
The experiment was conducted at field plots of Seed Technology Research Unit, Dr. PDKV Akola, during kharif season of 2012, 2013 and 2014. The variety AKM- 8802 was utilized in

the current study. Two foliar sprays of maleic hydrazide at concentrations 125, 250,375 and 500 ppm, ascorbic acid at concentrations 50,100 and 150 ppm and salicylic acid at concentrations 100 and 200 ppm were given to the crop at grain filling stage i.e. 50 and 60 days after sowing. The experiment was laid out in Randomized Block Design (Gomez and Gomez, 1989) [5] with 10 treatments in combination with three replications having plot size 4 m X 5 m. The field observations were recorded replication wise in each treatment from randomly selected 10 plants namely initial plant stand, days to 50% flowering, days to maturity, no. of pods per plant, no. of seeds per plant, 100 seed weight, seed yield and the laboratory observations were recorded as germination per cent (As per ISTA Rule, 1999) [7], moisture content, seedling length, seedling dry weight and vigour index (Abdul Baki and Anderson, 1973) [1]. The vigour index-I was calculated from the germination percentage and seedling length and the vigour index-II was calculated from the germination percentage seedling dry weight. The post harvest observations on seed quality were recorded at the five days interval up to the germination of treated seed becomes above MSCS (Minimum Seed Certification Standard) level.

Result and Discussion

As per three years pooled data, yield and yield attributing characters of mungbean are presented in table 1. The data showed that days to maturity, number of pods per plant, number of seeds per plant and seed yield were significantly influenced by the different chemical treatments except 100 seed weight. The early maturity (63 days) was observed by the foliar sprays of maleic hydrazide. @ 375 ppm. Highest number of pods per plant (22.43), maximum number of seeds per plant (179.20) and highest seed yield (12.71 q/ha) were recorded in the treatment T_2 i.e. maleic hydrazide @ 250 ppm at par with the treatment T_5 i.e. ascorbic acid @ 50 ppm. The yield and yield attributing characters were found affected adversely the application of higher concentration of maleic hydrazide. This data confirmed the previous work of Ali *et al*. (2013) [2]. Gupta *et al*. (1985) [6] pointed out that the decreased in yield attributes may be a result of growth and respitory inhibitor nature of maleic hydrazide.

Table 1: Effect of foliar sprays of different chemicals yield and yield attributing characters in mungbean

Treatments	Days to maturity	No. of pods per plant	No. of seeds per plant	100 seed weight (g)	Seed yield (q/ha)
To- Control	64.0	19.80	158.40	3.8	10.87
T_1 -MH@125 ppm	64.3	20.83	166.40	3.8	11.35
T_2 -MH@250 ppm	63.3	22.43	179.20	3.8	12.71
T_3 -MH@375 ppm	63.0	21.00	168.00	3.8	11.74
T_4 -MH@500 ppm	64.0	19.80	158.40	3.9	10.39
T_5 -ASA50 ppm	64.3	22.23	177.63	3.7	12.11
T_6-ASA@100 ppm	63.3	20.46	163.20	3.5	11.41
T_7 -ASA@150 ppm	63.3	20.26	161.20	3.5	11.22
T_8- SA@100 ppm	64.0	21.00	168.00	3.8	11.81
T_9- SA@200 ppm	64.0	21.86	174.04	3.7	11.87
S.Em±	0.31	0.79	0.03	0.11	0.38
C.D.at 5%	0.94	2.36	1.00	NS	1.13

The seed quality parameters were recorded and presented in table 2,3,4,5 and 6. It was observed that the seed quality parameters were increased with decreasing the storage period except control. The germination percent was found to be significant during storage. All treatments were recorded low germination initially except control. The germination percent was increased during storage and treatment T_2 i.e. maleic hydrazide @ 250 ppm and T_3 i.e. maleic hydrazide @ 375 ppm shows germination above MSCS level (80%) and (81%) at 35 DAH respectively. While remaining treatments shows germination percentage above MSCS level 20-30 DAH. The results are in accordance with Menedal *et al*. (2016) [10] found that dormancy induce and germination percentage reduces upto 35% due to application of maleic hydrazide. Seedling length and seedling dry weight not much significantly influenced due to any foliar treatment. The vigour index- I and II were increased in the treatment T_2 i.e. maleic hydrazide @ 250 ppm, T_3 i.e. maleic hydrazide @ 375 ppm and T_4 i.e. maleic hydrazide @ 500 ppm upto 35 days and then it was decreased due to the increase of storage period. The results are in accordance with Katkade *et al*. (1986) [8] and Nagarjun *et al*. (1980) [12] they reported that the vigour index showed a significant positive association with germination percentage and seedling length.

The foliar application of different chemicals at different concentrations increased the subsequent germination of seeds due to induction of dormancy as compared to control. Among the treatments spraying of maleic hydrazide @ 250 ppm was found most effective in inducing the dormancy as if recorded germination above MSCS (80%) upto 35 DAH. The spraying of salicylic acid and ascorbic acid also found effective in inducing dormancy up to 20 to 30 DAH.

The work of earlier scientist revealed that, the application of an inhibitor could bring about certain changes in the physiological and biochemical processes like alternation in promoter to inhibitor ratio, moisture content of the seed, water absorption capacity of the seeds and protein content of the seed, which are responsible to make the seed dormant by way of arresting the growth of the embryo. This induction of dormancy may be result of metabolic changes taken place in the seed itself as explained by Vaithialingam and Rao (1973) [15] in their studies with maleic hydrazide application.

Hence, the foliar spraying of chemicals at 50 and 60 DAS are found to be useful in inducing seed dormancy in mungbean. The foliar sprays of malic hydrazide @ 250 ppm found to be beneficial in inducing seed dormancy up to 35 days without adversely affecting the yield.

Table 2: Effect of foliar sprays of different chemicals on germination per cent during storage

	Germination (%) days after harvest								
Treatment	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
To- Control	82.0 (64.90)	82.0 (64.92)	81.0 (64.18)	81.0 (64.18)	80.0 (63.44)	80.0 (63.43)	78.0 (62.04)	76.0 (60.68)	75.0 (60.00)
T_1 -MH@125 ppm	46.0 (42.70)	52.0 (46.15)	48.0 (48.45)	58.0 (49.60)	64.0 (53.13)	73.0 (58.70)	78.0 (62.03)	77.0 (61.36)	76.0 (60.68)
T_2 -MH@250 ppm	44.0 (41.55)	50.0 (45.00)	53.0 (46.72)	56.0 (48.44)	58.0 (49.61)	62.0 (51.94)	73.0 (58.70)	80.0 (63.44)	79.0 (62.74)
T_3 -MH@375 ppm	38.0 (38.05)	43.0 (40.98)	47.0 (43.28)	50.0 (45.00)	58.0 (49.60)	67.0 (54.94)	71.0 (57.42)	81.0 (64.18)	80.0 (63.45)
T_4 -MH@500 ppm	34.0 (35.67)	39.0 (38.64)	46.0 (42.70)	54.0 (47.30)	59.0 (50.19)	69.0 (56.17)	78.0 (62.04)	82.0 (64.92)	80.0 (63.44)
T_5 -ASA@50 ppm	49.0 (44.43)	54.0 (47.30)	60.0 (50.77)	68.0 (55.55)	77.0 (61.36)	78..0 (62.03)	80.0 (63.45)	79.0 (62.74)	78.0 (62.03)
T_6-ASA@100 ppm	42.0 (40.39)	50.0 (45.00)	59.0 (50.19)	67.0 (54.94)	78.0 (62.03)	80.0 63.44)	81.0 (64.18)	79.0 (62.73)	79.0 (62.73)
T_7 -ASA@150 ppm	30.0 (33.20)	44.0 (41.55)	47.0 (43.28)	57.0 (49.03)	63.0 (52.54)	71.0 (57.42)	76.0 (60.67)	78.0 (62.03)	76.0 (60.68)
T_8-SA@100 ppm	43.0 (40.98)	54.0 (47.29)	56.0 (48.45)	60.0 (50.78)	71.0 (57.42)	73.0 (58.70)	80.0 (63.45)	76.0 (60.68)	74.0 (59.35)
T_9-SA@200 ppm	40.0 (39.23)	48.0 (43.85)	50.0 (45.00)	62.0 (51.94)	72.0 (58.06)	79.0 (62.74)	80.0 (63.44)	78.0 (62.04)	72.0 (58.05)
S.Em±	0.22	0.39	0.20	0.21	0.32	0.33	0.44	0.43	0.21
C.D.at 5%	0.67	1.18	0.60	0.64	0.95	0.98	1.31	1.30	0.64

*Figures in parenthesis are arcsine values.

Table 3: Effect of foliar sprays of different chemicals on seedling length during storage

	Seedling length (cm) days after harvest								
Treatments	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
To- Control	37.2	38.2	38.4	37.8	36.6	36.5	36.5	36.4	34.0
T_1 -MH@125 ppm	31.8	35.6	35.6	35.9	37.2	38.4	38.0	37.0	35.0
T_2 -MH@250 ppm	28.0	31.5	32.3	35.0	37.0	38.2	37.0	37.0	36.0
T_3 -MH@375 ppm	26.0	31.8	33.0	35.0	38.1	38.2	38.5	36.3	33.0
T_4 -MH@500 ppm	24.2	32.6	34.2	35.0	37.0	37.5	38.0	38.1	37.1
T_5 -ASA50 ppm	32.0	34.6	35.0	36.0	38.0	38.5	38.8	37.0	35.1
T_6-ASA@100 ppm	31.0	36.6	37.2	37.5	38.0	38.2	38.0	38.0	35.0
T_7 -ASA@150 ppm	28.0	33.0	35.5	37.8	37.9	38.0	38.0	35.0	31.0
T_8- SA@100 ppm	34.0	36.0	36.4	37.0	37.4	38.0	38.0	38.2	36.0
T_9- SA@200 ppm	30.0	34.0	36.0	36.4	36.7	37.0	37.0	37.2	36.0
S.Em±	0.88	0.88	0.94	0.93	0.94	0.83	0.79	0.88	0.83
C.D.at 5%	3.00	3.02	3.22	NS	NS	NS	NS	NS	2.85

Table 4: Effect of foliar sprays of different chemicals on seedling dry weight during storage

	Seedling Dry Weight (g) days after harvest								
Treatment	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
To- Control	0.18	0.18	0.18	0.16	0.16	0.16	0.16	0.15	0.15
T_1 -MH@125 ppm	0.15	0.16	0.11	0.15	0.18	0.16	0.18	0.17	0.15
T_2 -MH@250 ppm	0.13	0.15	0.15	0.16	0.19	0.19	0.18	0.17	0.15
T_3 -MH@375 ppm	0.15	0.15	0.15	0.16	0.18	0.18	0.18	0.18	0.17
T_4 -MH@500 ppm	0.13	0.15	0.16	0.16	0.18	0.18	0.18	0.19	0.18
T_5 -ASA@50 ppm	0.15	0.18	0.18	0.18	0.19	0.19	0.19	0.18	0.16
T_6-ASA@100 ppm	0.15	0.16	0.18	0.18	0.19	0.19	0.19	0.19	0.16
T_7 -ASA@150 ppm	0.13	0.15	0.16	0.18	0.18	0.19	0.19	0.16	0.15
T_8-SA@100 ppm	0.16	0.18	0.18	0.19	0.20	0.19	0.19	0.19	0.18
T_9-SA@200 ppm	0.16	0.16	0.18	0.18	0.20	0.19	0.19	0.18	0.16
S.Em±	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C.D.at 5%	NS	0.025	0.03	0.024	0.023	0.03	0.03	0.03	0.023

Table 5: Effect of foliar sprays of different chemicals on vigour index –I during storage

	Vigour Index- I days after harvest								
Treatments	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
To- Control	3051.07	3131.07	3113.33	3062.47	2927.27	2919.57	2845.67	2765.07	2550.60
T_1 -MH@125 ppm	1465.47	1852.67	1995.07	2083.47	2382.13	2806.13	2965.33	2850.30	2661.30
T_2 -MH@250 ppm	1233.33	1575.67	1715.67	1961.33	2148.67	2369.73	2702.33	2961.33	2846.60
T_3 -MH@375 ppm	990.66	1368.07	1551.67	1751.33	2211.13	2560.73	2734.83	2942.97	2642.60
T_4 -MH@500 ppm	824.13	1274.33	1575.87	1892.67	2184.33	2590.17	2965.33	3126.87	2968.60
T_5 -ASA@50 ppm	1568.67	1871.33	2101.33	2449.33	2928.67	3004.33	3105.33	2924.33	2739.10
T_6-ASA@100 ppm	1303.33	1831.47	2196.13	2513.83	2964.67	3056.67	3080.67	3003.33	2766.30
T_7 -ASA@150 ppm	842.66	1453.33	1669.17	2155.93	2390.37	2698.67	2888.67	2730.67	2358.60
T_8-SA@100 ppm	1462.67	1945.33	2013.87	2222.67	2656.87	2776.67	3042.67	2905.87	2665.30
T_9-SA@200 ppm	1201.33	1632.67	1801.33	2258..27	2645.07	2924.33	2960.67	2904.27	2592.60
S.Em±	60.29	66.05	78.71	81.89	89.75	86.954	86.22	96.33	88.08
C.D.at 5%	205.66	225.29	268.49	279.33	306.15	296.59	294.10	328.60	303.20

Table 6: Effect of foliar sprays of different chemicals on vigour index –II during storage

	Vigour Index- II days after harvest								
Treatments	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**
To-Control	15.03	14.75	14.60	13.77	13.59	13.59	13.24	11.39	11.25
T_1 -MH@125 ppm	6.92	8.82	6.17	8.70	11.52	12.39	14.04	13.10	11.41
T_2 -MH@250 ppm	6.02	7.51	7.95	9.53	11.81	12.41	12.87	13.59	11.82
T_3 -MH@375 ppm	5.84	6.31	7.05	8.48	10.45	12.07	12.55	14.56	13.61
T_4 -MH@500 ppm	4.88	5.85	7.83	9.19	10.81	12.20	14.04	16.38	14.40
T_5 -ASA@50 ppm	7.33	9.73	10.81	12.24	15.67	14.56	16.28	14.22	13.25
T_6-ASA@100 ppm	6.44	8.49	10.62	12.27	15.35	16.00	16.45	15.81	13.43
T_7 -ASA@150 ppm	4.32	6.76	7.97	10.26	11.33	13.97	15.45	13.26	11.64
T_8-SA@100 ppm	7.44	9.91	10.9	12.19	14.43	14.83	16.25	15.22	13.31
T_9-SA@200 ppm	6.81	8.17	8.98	10.95	14.14	15.78	16.26	14.06	12.48
S.Em±	0.45	0.43	0.62	0.49	0.51	0.57	0.61	0.68	0.56
C.D.at 5%	1.54	1.49	2.14	1.68	1.53	1.95	2.09	2.34	1.68

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