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Impact of excess application of growth inhibitor for initiation of seed dormancy in Rice (*Oryza sativa* L.)

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Abstract
A field experiment to induce dormancy in rice (*Oryza sativa* L.) was conducted during *Kharif* season, 2017-2018 at the experimental field of Department of Crop Physiology, ANDUA&T, Ayodhya to study the effect of foliar feeding with growth inhibitors by different concentration *viz*. Maleic Hydrazide (500ppm and 1000ppm) and Cycocel (500ppm and 1000ppm) along with untreated control. The experiment was laid out in randomized block design comprising nine treatments at two stages (*viz*. flowering stage and anthesis stage) in three replications. Observations had been studied *in vivo* on germination percentage, viability test. Yield characters *i.e.*, number of tillers per plant, ear bearing tillers per plant and biomass per plant, number of seeds per panicle, grain yield per plant and harvest index. Among all the concentrations, maximum number of tillers per plant, ear bearing tillers per plant and number of seeds per panicle was recorded in MH@1000ppm, grain yield per plant and biomass per plant MH@500ppm, harvest index was found maximum in cycocel @500ppm followed by MH@1000ppm where as maximum inhibition of germination was observed with cycocel@1000ppm followed by MH @1000ppm and cycocel @500ppm but cycocel @ 500ppm was found most appropriate and was very much effective for safe induction of seed dormancy in rice because of its minimum viability loss. Loss in viability was may be due to some toxic effect caused by high concentration of MH and cycocel.

Keywords: Cycocel, foliar feeding, induction, maleic hydrazide, rice, seed dormancy, viability

Introduction
Rice (*Oryza sativa* L., 2n= 24), belongs to the family Poaceae (Graminae). It is the most important food crop of the developing world and is the staple food of more than half of the world's population. Rice contributes 43% of total food grain production and 46% of the total cereal production of the country. According to United States Department of Agriculture (USDA) rice production in 2017-2018 is 112.9mt. India stands on rank 1st with respect of area (45.35 ha.) and 2nd in production (112.9 Mt.).

Seed quality has multiple concepts having several components such as genetic purity, Physical Purity, insect-pest, weeds, germination, moisture content, vigour and uniformity. The quality seed is the main and principle mean to secure crop yield in less favorable areas, and this is the main vehicle for rehabilitation in agriculture. The inability of newly harvested seeds to continue their development under favourable environmental conditions like moisture, temperature, oxygen supply is generally known as Dormancy. It is the natural phenomenon in the plant kingdom. It allows plant to survive under unfavorable environmental conditions. It is generally assumed that dormancy is mainly of two types *i.e.* Primary and Secondary types.

The dormancy due to embryo factors or due to seed coat is called as Primary dormancy. The state of dormancy in seed may also be induced due to secondary factors like light, temperature etc. is called as secondary dormancy. Dormancy is a mechanism by which seeds maintain their viability in unfavorable conditions. The characteristics of dormancy may be considered as beneficial in short duration varieties because the crop attains the maturity stage in rainy season itself at that time the proper threshing may not be possible. On the other side it possess cereal problem in testing giving misleading result and require induction of dormancy. Post-harvest sprouting is nowadays became a serious problem which adversely affect the quality of seeds and make farmers suffer from great loss. There are many chemicals and plant hormones by which dormancy can be induced.

Materials and Methods

The experiment was carried out under normal field conditions in Kharif season during 2018-19 at crop physiology field of Acharya Narendra Deva University of agriculture and technology, Narendra nagar, Kumarganj, Ayodhya (U.P). Seeds of sambha mahsuri were brought from Nagipur seed research farm, ANDUAT Kumarganj, Ayodhya and nursery was raised. Thirty days old seedling was transplanted to the properly ploughed and lavelled field of Crop Physiology department. Three seedlings were used for transplanting and the experimental design was RBD (Randomised Block Design). Nine treatments were allocated with three replications. All the package of practices was followed as per the general agronomic practices for rice crop. Solutions of M.H@500ppm, 1000ppm and cycocel @500ppm and 1000ppm were prepared by weight by volume (w/v) and volume by volume (v/v) basis and sprayed before flowering and anthesis stage and the observation was recorded at flowering, anthesis and maturity stage. Number of tillers per plant was recorded by counting 5plants at each stage of observation. Numbers of seeds were counted from five panicles in each replication. Earbearing tillers plant^{-1} was recorded by counting at maturity stage of observation. Five healthy and uniform plants from each treatment were sampled and dried till a constant weight was achieved. The weight was recorded with the help of electronic balance and biomass per plant is computed.

Harvest index in different treatments was worked out by following formula given by Donald (1962).

The main objective of this experiment was to induce safe dormancy in the rice seeds and dormancy can only be examined by conducting germination test immediately after harvest. Seed germination test was done in the laboratory as per ISTA procedure by adopting the rolled paper towel method at 25^{0}C temperature and 90±5 percent relative humidity in seed germinator. The number of germinated seeds was counted and the germination percentage was calculated as per the formula given below:

$$\text{Germination (\%)} = \frac{No.of normal seedlings}{Total number of seeds} \times 100$$

Viability test (Tz test) was determined immediately after harvest by tetrazolium test as described by Lakon (1949) and the seeds were evaluated as viable or dead on the basis of staining pattern in embryo.

Result and Discussion

Number of tillers per plant at anthesis and maturity stage showed significant effect. At anthesis stage maximum number of tillers was noticed with MH@1000ppm (before anthesis stage) followed by MH @500ppm (before flowering stage).

Significantly higher number of tiller per plant was observed with foliar spray of MH @1000ppm (before anthesis stage) followed by MH@500ppm (before flowering stage). When compared with control all the treatments showed increase in tiller number per plant. This might be because of photosynthetic activity and efficiency of leaves have been increased which contributed to dry matter production. Similar finding was accordance with Chaudhary *et al.*, (1980) with cycocel in rice, Kouthe *et al.*, (2003) with cycocel @100 and 200ppm, Nawalgatti *et al.*, (1991) [3] with cycocel @1000ppm in groundnut. Maximum ear bearing tillers and grain per panicle was found maximum in MH@1000ppm before flowering stage. MH@500ppm (before flowering stage) showed maximum grain yield per plant and biomass per plant. This finding is conformity with Suman *et al.* (2017) [4] with cycocel, Hunje *et al.*, (1995) [5] with cycocel @100ppm on cow pea, Rathore *et al.*, (1990) [6] with cycocel @2000ppm in cluster bean, Singh *et al.*, (1988) [10] with cycocel on Indian mustard, Sheelavantkar *et al.*, (1988) [12] with cycocel @1000ppm. Maximum harvest index was found in cycocel @500ppm (before flowering) and maximum panicle length was observed in MH@500ppm (before anthesis stage). This finding is accordance with Singh *et al.*, (1988) [10] with cycocel on Indian mustard and Singh *et al.*, (2009) [11] with cycocel @50, 100ppm on cotton.

Data pertaining seed viability and germination (%) clearly indicated that foliar application of maleic hydrazide @500ppm and 1000ppm before flowering suppressed the seed germination by 74% and 80% accompanied with higher seed viability *i.e.* 96.00%. Similarly foliar application of high concentration of maleic hydrazide and cycocel at anthesis stage showed more significant effect to induce dormancy. Mean while foliar application of cycocel and maleic hydrazide at anthesis showed inhibition of germination to 83% and 82% but also cause more detrimental effect to seed viability *i.e.* loss of seed viability. Loss of seed viability might be due to higher concentration of maleic hydrazide and cycocel which cause some toxic effect that hamper the viability of the seeds (93.00%). So, it can be easy concluded that cycocel @500ppm is best for dormancy induction and appropriate stage is anthesis stage for the safe induction of seed dormancy in rice. Concentration of Cycocel@ 500ppm caused maximum viability and more inhibition in germination. It can be easy concluded that cycocel @500ppm is best for dormancy induction and appropriate stage is anthesis stage for the safe induction of seed dormancy in rice. This finding is supported by Nagarjun and Radder (1983) [7] with MH at 75 and 90DAS, Randhawa and Nandpuri (1966) [9] with MH @1000ppm in onion bulbs, Jayadeva, (2008) [8] with MH @100ppm in groundnut.

Table 1: Effect of foliar application of growth retardant (M.H and Cycocel) in number of tillers per plant of rice (*Oryza sativa* L.)

Treatments	At flowering	At anthesis	At maturity
T1: Control	8.85	10.44	10.22
T2: Foliar spray of MH@500ppm before flowering	9.25	11.57	10.48
T3: Foliar spray of MH@1000ppm before flowering	9.07	11.11	10.96
T4: Foliar spray of Cycocel @500ppm before flowering	8.99	10.55	10.44
T5: Foliar spray of Cycocel @1000ppm before flowering	8.92	10.77	10.70
T6: Foliar spray of MH@500ppm before anthesis	9.40	11.56	11.00
T7: Foliar spray of MH@1000ppm before anthesis	9.51	11.84	11.99
T8: Foliar spray of cycocel @500ppm before anthesis	8.86	11.28	10.88
T9: Foliar spray of Cycocel @1000ppm before anthesis	8.92	10.77	10.66
Grand Mean	9.09	11.10	10.81
SEm±	NS	0.17	0.17
CD at 5%	NS	0.50	0.51

Table 2: Effect of foliar application of growth retardant (M.H and Cycocel) on ear bearing tillers and number of grains per panicle of rice (*Oryza sativa* L.)

Treatments	Ear bearing tillers	Number of grains per panicle	Grain yield per plant (g)	Biomass per plant (g)
T1: Control	6.77	224.11	9.10	26.59
T2: Foliar spray of MH@500ppm before flowering	7.00	239.10	9.95	28.85
T3: Foliar spray of MH@1000ppm before flowering	8.44	269.55	9.60	26.89
T4: Foliar spray of Cycocel @500ppm before flowering	6.78	250.22	9.80	27.31
T5: Foliar spray of Cycocel @1000ppm before flowering	7.77	236.33	9.40	27.25
T6: Foliar spray of MH@500ppm before anthesis	7.74	247.77	9.74	27.95
T7: Foliar spray of MH@1000ppm before anthesis	7.88	227.44	9.70	27.32
T8: Foliar spray of cycocel @500ppm before anthesis	7.85	251.22	9.68	27.70
T9: Foliar spray of Cycocel @1000ppm before anthesis	7.30	242.88	9.90	28.82
Grand Mean	7.49	243.18	9.65	27.63
SEm±	NS	4.57	0.09	0.26
CD at 5%	NS	13.71	0.26	0.79

Table 3: Effect of foliar application of growth retardant (M.H and Cycocel) on Harvest Index (%) and panicle length (cm) of rice (*Oryza sativa* L.)

Treatments	Harvest Index (%)	Panicle length (cm)
T1: Control	34.22	20.87
T2: Foliar spray of MH@500ppm before flowering	34.48	21.50
T3: Foliar spray of MH@1000ppm before flowering	35.70	21.58
T4: Foliar spray of Cycocel @500ppm before flowering	35.88	21.59
T5: Foliar spray of Cycocel @1000ppm before flowering	34.49	21.81
T6: Foliar spray of MH@500ppm before anthesis	34.84	22.09
T7: Foliar spray of MH@1000ppm before anthesis	35.50	22.04
T8: Foliar spray of cycocel @500ppm before anthesis	34.94	21.65
T9: Foliar spray of Cycocel @1000ppm before anthesis	34.35	21.99
Grand Mean	34.93	21.68
SEm±	NS	0.12
CD at 5%	NS	0.37

Table 5: Effect of foliar application of growth inhibitors (M.H and Cycocel) on seed viability and germination percent of rice (*Oryza sativa* L.)

Treatments	Seed viability (%)	Germination (%)
T1: Control	96.00	95.00
T2: Foliar spray of MH@500ppm before flowering	96.00	26.00
T3: Foliar spray of MH@1000ppm before flowering	96.00	20.00
T4: Foliar spray of Cycocel @500ppm before flowering	93.00	32.00
T5: Foliar spray of Cycocel @1000ppm before flowering	93.00	29.00
T6: Foliar spray of MH@500ppm before anthesis	96.00	27.00
T7: Foliar spray of MH@1000ppm before anthesis	94.00	18.00
T8: Foliar spray of cycocel @500ppm before anthesis	96.00	18.00
T9: Foliar spray of Cycocel @1000ppm before anthesis	93.00	17.00
Grand Mean	94.77	38.16
SEm±	0.59	2.44
CD at 5%	1.75	7.33

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