

EFFECT OF FOLIAR APPLICATION OF GROWTH RETARDANT ON YIELD AND GERMINABILITY OF HYBRID RICE

M. THOITHOI DEVI*, OMOVATI VERMA, MAYA KRISHNA AND SEEMA

Department of Agronomy, College of Agriculture,
Govind Ballabh Pant University of Agriculture & Technology, Pantnagar – 263145, U. S. Nagar, Uttarakhand
e-mail: thoiaagri@gmail.com

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***Corresponding author**

ABSTRACT

The application of gibberellic acid (GA₃) increased per cent seed set from 38.3% to 48.0% in hybrid rice. This increase was due to increase in number of filled grains per panicle. Ethrel application at different stages did not significantly influence seed yield of hybrid rice however, the highest seed yield (950 kg/ha) was recorded for GA₃ application followed by ethrel application 12 days after GA₃ application (925kg/ha). During storage, germination percentage in early months of storage did not changed much in all the hybrid rice treatments. Whereas after six month of storage, maximum germination of 76.0 % was recorded in the treatment where ethrel was sprayed 4, 8 and 12 days after GA₃ application and lowest (52.5%) was recorded in the GA₃ application treatment. Our study revealed that ethrel application following GA₃ does not adversely affect seed quality and crop productivity but improved seed storability of hybrid rice.

INTRODUCTION

The cytoplasmic male sterile (CMS) lines of rice have imperfect panicle exertion i.e. at least 25% spikelets remain enclosed in the flag leaf sheath and are not available for out crossing. In addition, the erect flag leaves of the female parent also obstruct the pollen transfer from pollen parent to its receptive stigma at the time of pollination. To overcome the problem of panicle exertion and increase out crossing, application of gibberellic acid (GA₃) is recommended (Anonymous, 1998). Application of GA₃ for hybrid rice seed production is the corner for poor storability of seeds produced as GA₃ induces α -amylase activity (Ponnuswamy and Prabakaran, 1997). It was hypothesized that once the objective of gibberellin application (outcrossing) is completed, the harmful effect (induction of α -amylase activity) may be reduced by the use of growth retardants which interfere with gibberellic acid action. Ethrel has growth retardant property, therefore, application of this chemical during seed development may inhibit or reduce α -amylase activity induced by GA₃ application leading to improved seed storability. On the other hand, ethrel application may have harmful effect on crop metabolism and may adversely affect seed yield. Therefore, the experiment was planned to study the effect of ethrel application on seed yield and seed quality with reference to maintenance of germination during storage of hybrid rice.

MATERIALS AND METHODS

The experiments were conducted at G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) to find out the effect of plant growth regulators on seed yield and

seed quality of hybrid rice during storage. The experiments were laid out in randomized block design with 4 replications. Gibberellic acid was sprayed @ 150 g GA₃/ ha at 5% panicle emergence in hybrid rice (Pant Sankar Dhan 3). After GA₃ application ethrel was sprayed @ 2500 ppm after 4, 8 and 12 days interval in hybrid rice. Transplanting of the seedlings was done on 13th July 2010. The crop was grown as per recommended cultural practices for hybrid rice cultivation and harvesting of the crop was done on 30th October 2010.

The number of panicle per hill was computed by randomly selecting five hills at maturity and averaged. For computing number of filled grains/panicle, a sample of twenty panicles was taken and threshed separately. The seeds obtained were manually separated into filled and unfilled seeds and counted and calculated the per cent seed set. Weight of filled grains was averaged to get weight of filled seeds per panicle. The cleaned produce will be weighed to record seed yield and 1000 seed weight. The samples were dried in sun to reduce moisture content to 13% and kept in cloth bag under ambient condition for germination studies during storage. At bimonthly interval germination percentage was calculated on the basis of number of normal seedlings as per ISTA guidelines (Anonymous, 1985).

RESULTS AND DISCUSSION

The data on number of panicles/hill, number of filled grain / panicle, seed set per cent, grain weight /panicle, 1000 grain weight, seed yield and germination percentage are given in Tables 1 and 2. The application of gibberellic acid (GA₃)

increased per cent seed set from 38.3% (without GA₃ application) to 48.0% (application of GA₃). This increased seed set in case of GA₃ application in hybrid rice was due to increase in number of filled grains per panicle which was 22.2 in case of without GA₃ application and 26.6 in application of GA₃ alone. The higher rate of outcrossing caused by GA₃ application resulting into higher percentage of seed set in hybrid rice has also been reported by Pandey *et al.* (2003).

The highest yield (950 kg/ha) was obtained with the application of only GA₃. It was 52% higher than that obtained without GA₃ application. Higher yield with GA₃ application than without GA₃ application can be attributed to better seed set resulting into higher number of filled grains per panicle leading to high grain weight per panicle with GA₃ application than without GA₃ application (Table 1). Similar results had also been reported by Rahman *et al.* (2012) where in they reported that application of GA₃ @250 g/ha showed maximum seed yield which was significantly higher than that of without GA₃ application. Niknejhad and Pirdashti (2012) also found that application of GA₃ markedly increased rice grain yield and grain number per panicle (up to 32 and 40 % respectively) as compared to untreated plants. Among the treatments, the highest 1000 seed weight was observed in hybrid rice without GA₃ application which was statistically at par with all the treatments involving hybrid rice except ethrel application sprayed 4, 8 and 12 days after GA₃ application. According to Siddiq *et al.* (1994) and Singh *et al.* (2003) application of GA₃ increased the number of spikelets per panicle, spikelet fertility, 1000 grain weight and seed yield. Among the treatments in

which ethrel was applied after GA₃ application, the highest seed yield of 925 kg/ha was observed with ethrel application 12 days after GA₃ followed by ethrel application 8 days after GA₃ application and the minimum seed yield was jointly observed with ethrel application 4 days and ethrel application 4 and 8 days (575.0 Kg/ha) followed by ethrel application 4, 8 and 12 days after GA₃ application. The differences in seed yield among all the hybrid rice treatments were non-significant. These results indicated that growth retardant i.e. ethrel had no significant adverse effect on seed yield of hybrid rice.

The storage studies revealed that, the differences in germination percentage among the treatments were less pronounced during early months of storage which ranges from 79.3 to 85.8% (Table 2). Abo-Youssef *et al.* (2010) reported that germination index increased with increasing GA₃ dose from 0, 300, 350 and 400g/ha when germination was conducted just after harvesting of the crop. But with the advancement of storage period, the differences were more conspicuous. After six month of storage, the highest germination was recorded with ethrel application sprayed thrice 4, 8 and 12 days after GA₃ application (76.0%). It was significantly higher than that of ethrel application 4 days after GA₃ application (71.5%) and ethrel application 4 and 8 days after GA₃ application (71.5%), without GA₃ application (70.5%) and GA₃ application (52.5%) and was at par with rest of the treatments. The lowest germination (52.5%) was recorded with GA₃ application treatment. The lowest germination in case of GA₃ application in hybrid rice may be due to adverse effect of GA₃ application through increased α -amylase activity which reduced seed

Table 1: Effect of GA₃ and ethrel application on yield attributing parameters and seed yield of hybrid rice

Treatment	No. of panicles/hill	No. of filled grains/panicle	% seed set	Grain weight (g)/panicle	1000 seed weight (g)	Seed yield (Kg/ha)
T ₁ - Hybrid rice (without GA ₃ application)	10.9	22.2	38.3	0.426	19.2	625.0
T ₂ - GA ₃ application in hybrid rice	9.3	26.5	48.0	0.507	19.0	950.0
T ₃ - T ₂ + ethrel application 4*	10.3	23.5	40.4	0.450	19.1	575.0
T ₄ - T ₂ + ethrel application 8*	10.1	23.0	38.1	0.412	18.0	675.0
T ₅ - T ₂ + ethrel application 12*	9.5	33.4	46.8	0.621	18.6	925.0
T ₆ - T ₂ + ethrel application 4 and 8*	9.4	13.7	25.5	0.241	17.4	575.0
T ₇ - T ₂ + ethrel application 4 and 12*	9.6	22.4	35.2	0.423	18.8	650.0
T ₈ - T ₂ + ethrel application 8 and 12*	10.6	23.7	39.0	0.450	18.7	625.0
T ₉ - T ₂ + ethrel application 4,8 and 12*	11.4	12.6	26.4	0.207	16.6	600.0
SEm ±	0.7	4.4	4.8	0.108	0.7	146.3
CD at 5%	1.9	12.6	13.9	0.321	2.0	422.4

* Days after GA₃ application

Table 2: Effect of GA₃ and ethrel application on germination percentage of hybrid rice seed during storage

Treatment	Germination (%) during storage (months)			
	Initial	2	4	6
T ₁ - Hybrid rice (without GA ₃ application)	81.8	82.3	79.5	70.5
T ₂ - GA ₃ application in hybrid rice	85.8	82.0	78.5	52.5
T ₃ - T ₂ + ethrel application 4*	79.3	79.5	76.0	71.5
T ₄ - T ₂ + ethrel application 8*	82.8	81.0	79.5	72.3
T ₅ - T ₂ + ethrel application 12*	79.5	82.0	81.0	74.5
T ₆ - T ₂ + ethrel application 4 and 8*	81.0	80.0	67.5	71.5
T ₇ - T ₂ + ethrel application 4 and 12*	83.3	79.5	74.8	75.5
T ₈ - T ₂ + ethrel application 8 and 12*	83.3	80.8	79.3	73.8
T ₉ - T ₂ + ethrel application 4,8 and 12 *	80.5	79.8	73.5	76.0
SEm ±	2.0	2.0	1.9	1.5
CD at 5%	6.0	5.7	5.4	4.2

*: Days after GA₃ application

storability. Poor seed storability of the seeds of hybrid rice plants treated with GA₃ has been reported by Duan and Ma (1992) and Huang *et al.* (1997). Superiority in germination of the seeds obtained by all the ethrel application treatments following by GA₃ application suggested that ethrel could nullify the adverse effect of GA₃. These findings are in conformity with the findings of Jat (2007) who attributed the superiority of ethrel and cycocel application after GA₃ in hybrid rice seed production to reduce α-amylase activity and advocated that application of growth retardants inhibited GA₃ induced α-amylase activity in hybrid rice.

From the above study it can be summarized that ethrel application following GA₃ does not adversely affect seed quality and crop productivity but improved seed storability of hybrid rice. After six months of storage period, foliar application of ethrel increased the germination percentage of seeds up to 40 % over GA₃ application and application of ethrel was found more effective when it was sprayed in splits.

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