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RESEARCH ARTICLE

Assessment of yield and physiological parameters in (KRH-2) hybrid rice seed production (A×R) by using exogenous gibberellic acid

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SUMMARY

An experiment was conducted to study the effect of plant growth regulators in proper seed setting of hybrid rice (KRH-2) seed production using gibberellic acid (GA_3) on the physiological efficiency of rice. The physiological parameters and their relation with growth and yield attributes were analysed in this experiment. The experiment consisted of five treatments *viz.*, T_1: application of 10 ppm GA_3 at pre flowering stage, T_2: application of 20 ppm GA_3 at pre flowering stage, T_3: application 10 ppm GA_3 at post flowering stage and T_4: application of 20 ppm GA_3 at post flowering stage T_5: Control. It was revealed that GA_3 applied on hybrid rice (KRH-2) seed production, at different stages of growth had improved significantly the yield attributes namely number of filled grains, 1000 grain weight and total yield of female line etc. with significant effect on growth parameters leading to enhancement in better seed set and ultimately better grain yield of both male and female lines of (KRH-2) hybrid rice seed production. Application of 20 ppm GA_3 at pre flowering stage, was found to be superior over other treatments. Gibberellic acid treatment significantly increased the yield of female line and this may be due higher photosynthetic contribution after flowering thereby enhanced 40-50 per cent higher grain yield over control.

Key Words : Gibberellic acid, Seed production, Hybrid rice (KRH-2), Pre-flowering, Post flowering

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The success of hybrid rice cultivation depends on the success of the hybrid rice seed production programme which enables seed producers to produce high quality seed at an economical price. Hybrid rice seed production requires specialized techniques which must be fully understood by the production staff. Hybrid rice seed production using the CMS system, *i.e.*, the three-line system: A line (female), B line (maintainer) and R line (restorer) involves three steps:

Like in other crops, the first generation progeny (F1) obtained by crossing two genetically different varieties (parents) of rice is called 'Hybrid'. Since rice is self pollinated, cytoplasmic male sterile (CMS) parent is used as female parent, which is normally called 'A' line. The fertility restoring line which is called 'pollinator' to the female parent is known as male parent. It is generally referred to as 'R' line, and is used for hybrid seed production. The hybrid combines the desirable characters from CMS line and R line. They exhibit vigor for several quantitative characters including yield. They exhibit buffering capacity to counteract several biotic and abiotic factors that limit productivity. While developing/evaluating hybrids, the combinations of varieties that exhibit vigor or heterotic effect for yield are selected. The hybrid seed is purchased or procured afresh every year/ season for raising the commercial crop. The harvested grains from hybrid crop should not be used for planting the next crop.

Hybrid seed production :

The success of hybrid rice technology primarily depends on genetic purity, timely availability and the affordability of hybrid seed costs to the farmers. The production of pure hybrid seed at affordable price in rice- a self-pollinated crop, is a highly skill oriented activity. A good hybrid may not reach a large number of farmers, unless it is feasible to commercially produce the seed on large scale economically. Though there are two systems (2-line and 3- line) hybrid breeding and seed production, but at presently three line method, using cytoplasmic male sterility system. In this system, three lines (parents) are involved in hybrid seed production. These parents are:

A line :

It is cytoplasmic male sterile line, which is used as female parent in hybrid seed production. It is maintained by crossing with the B line (maintainer line). Both these lines are iso-genic having homozygous recessive nuclear genes conferring male sterility, differing only in cytoplasm which is sterile (S) in A line and fertile (N) in its maintainer line.

B line :

It is iso-genic to A line and is used as pollen parent to maintain male sterility in A line. This line is maintained by growing in isolation.

R line :

This is also called as fertility restorer or pollinator line. This is used in hybrid seed production by growing along-with A line in a standard row ratio. It is also maintained by growing in isolation, at least 5 m away from any rice variety.

Hybrid seed production technology is quite different from the technology for varietal seed production. Fresh hybrid seed is essentially purchased / procured by the farmers every year/season. The hybrid seed should have the purity of about 99 per cent. Strict isolation of seed production areas and thorough roguing of the 'off type' plants can help to achieve required seed purity of > 99.8 per cent. Therefore, utmost care has to be taken while producing the hybrid seed.

Physiological role of GA_3 :

Application of GA_3 it is an efficient and effective growth hormone, which stimulates the cell elongation and thus advances the panicle exertion in female line. in addition to this GA_3 also increases the duration of opening, thus ensures pollination, increases stigma exertion and receptivity, promotes plant height and flowering, promotes panicle exertion and growth rate of secondary and tertiary tillers.

Application of suitable growth regulators at optimum concentration may regulate vegetative growth and can be used to have a proper balance between source and sink for increasing the yield of crop. Role of growth regulator in the transport and regulation of metabolites from source to sink in rice has well documented (Biswas and Choudhury, 1981). The exogenous application of various chemicals which are either promotory or inhibitory, might stimulate the metabolic process (Godai and Barhuah, 2000). The most significant physiological effect of exogenous gibberellic acid (GA_3) on plants is to break dwarfism and stimulate the elongation of genetically dwarf genotypes, as these dwarf lines generally have low level of endogenous GA_3 in their tissues. The present investigation was, therefore, planned to investigate the influence of growth regulator (GA_3) on crop efficiency and better seed set and productivity of (KRH-2) hybrid rice seed production (Proceedings of the 20th session of the International rice Commission, Bangkok).

MATERIAL AND METHODS

This experiment was planned at College of

Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India during the year 2011-12 in a Randomised Complete Block Design with five treatments and four replications. KRH-2 hybrid rice parental seeds were given by Charoen Pokphand Seeds India Pvt. Ltd., Bangalore (Karnataka) on bye back agreement basis. Therefore the following treatments *viz.*, T_1: Application of 10 ppm GA_3 at pre flowering stage, T_2: Application of 20 ppm GA_3 at pre flowering stage, T_3: Application 10 ppm GA_3 at post flowering stage, T_4: application of 20 ppm GA_3 at post flowering stage T_5: Control were followed in plot size 10 × 10 Mt. For experiment A×R seedlings were raised separately with different staggering and maintained for duration of one month and transplanted to main field with 8:2 proportion (female to male ratio) and female (A line) planted one seedling per hill and male (R line) 2-3 seedlings per hill were planted with distance of 15 cm plant to plant in both male and female and 20 cm between row to row in female but between row to row in male line 30 cm was followed for better movement and crop management.

Leaf clipping :

Leaf clipping of A and R lines is helpful for better out-pollination and seed set. Long and erect flag leaf may obstruct pollen dispersal from the R to the A line and affects the out crossing rate. Flag leaves should be clipped off in such cases, when the main culms are still in the boot leaf stage. Flag leaf clipping gives uniform distribution of the pollen over A line plants.

Supplementary pollination :

Was done 3-4 times per day with 20-30 minutes gap for 10- 12 days by shaking male parent with the help of nylon rope at the time of peak Anthesis so as to disperse pollen grains and to increase the seed set on the female parent. With improved management of parents and effective supplementary pollination, hybrid seed yield can be increased significantly (Proceedings of the 20th session of the International rice Commission, Bangkok).

Rouging :

Purity of the hybrid seed is top priority for the production of quality seed. Rouging of off-types and voluntary plants at several stages is essential for obtaining physical and genetic purity. Rouging was done by the removal of undesirable rice plants from both parents (male and female). Undesirable plants include off-types (eg. maintainer or B-type plants in A line). Off-type plants can be identified by their morphological characters (eg. height, leaf size, leaf shape and colour, panicle shape, panicle size and pigmentation) in the late vegetative/early flowering period.

Harvesting operations :

In order to maintain high purity, extreme care was taken at harvesting and threshing. Just before harvesting, checked female rows for left-over pollen shedders, off-types and male parent plants (restorers). After confirmation that the field does not contain unwanted plants, the male rows were harvested first and all panicles carefully removed. Moved the harvested male plants to a separate threshing floor where only male parents should be threshed. The female rows which were ready for harvest was carefully rechecked for left-over plants or panicles of male (restorer) parents. Female plants were harvested and threshed on a separate threshing floor. The threshing floor should be free from seed of the previous crop and must be very clean. Harvesting and threshing was be done by manually to avoid admixture with other varieties of paddy. After threshing, the seeds were properly dried and bagged. The bags need to have labels inside and outside, listing all necessary details, such as lot identification or lot number, date of harvest and quantity of lot etc. (Proceedings of the 20th session of the International rice Commission, Bangkok).

RESULTS AND DISCUSSION

Application of GA_3 on both male and female lines of KRH-2 was taken up in hybrid rice seed production experiment during the *Kharif* season 2011-12 and it was 10 ppm and 20 ppm sprayed in different stages of the crop (pre and post flowering). GA_3 helped to get very much uniform flowering and effective synchronisation in (A×R) KRH-2 hybrid rice seed production. Panicle poor exertion from flag leaf sheath is a problem in cytoplasmic male sterile lines. Similarly quoted by Duan and Ma (1992) that, by foliar application of GA_3 is an essential technique in promoting panicle exertion and obtaining high cross-pollinated seed set in hybrid rice seed production. During this study, KRH-2 hybrid rice was evaluated for 1000 grain weight which was varied among the treatments from 15.3 to 21.5 g/1000 grains and it was highest in T_2 treatment *ie*. 21.5 g followed by 19.5 g (T_3) compared to control (Table 1).

Table 1 : Yield and yield attributes as influenced by different concentration of GA_3 in KRH-2 hybrid rice seed production

Treatments	Test weight (g/1000 grains)	No. of tillers (No./m^2)	No. of filled grains (No./panicle)	No. of unfilled grains (No./panicle)	Total no. of grains (No./panicle)	Spad values	Grain yield (t/ha)
T_1	16.3	394.8	59.8	32.0	91.8	25.3	1.74
T_2	21.5	444.0	82.0	23.5	105.5	26.1	2.53
T_3	19.5	439.8	77.5	27.8	105.3	26.2	2.40
T_4	18.8	426.5	71.5	31.8	103.3	25.0	2.28
T_5	15.3	320.3	53.8	33.3	87.0	25.8	1.53
S.E. ±	0.67	3.9	3.08	1.76	3.33	0.73	0.07
C.D. (P=0.05)	2.07	11.9	9.48	5.44	10.27	2.24	0.20

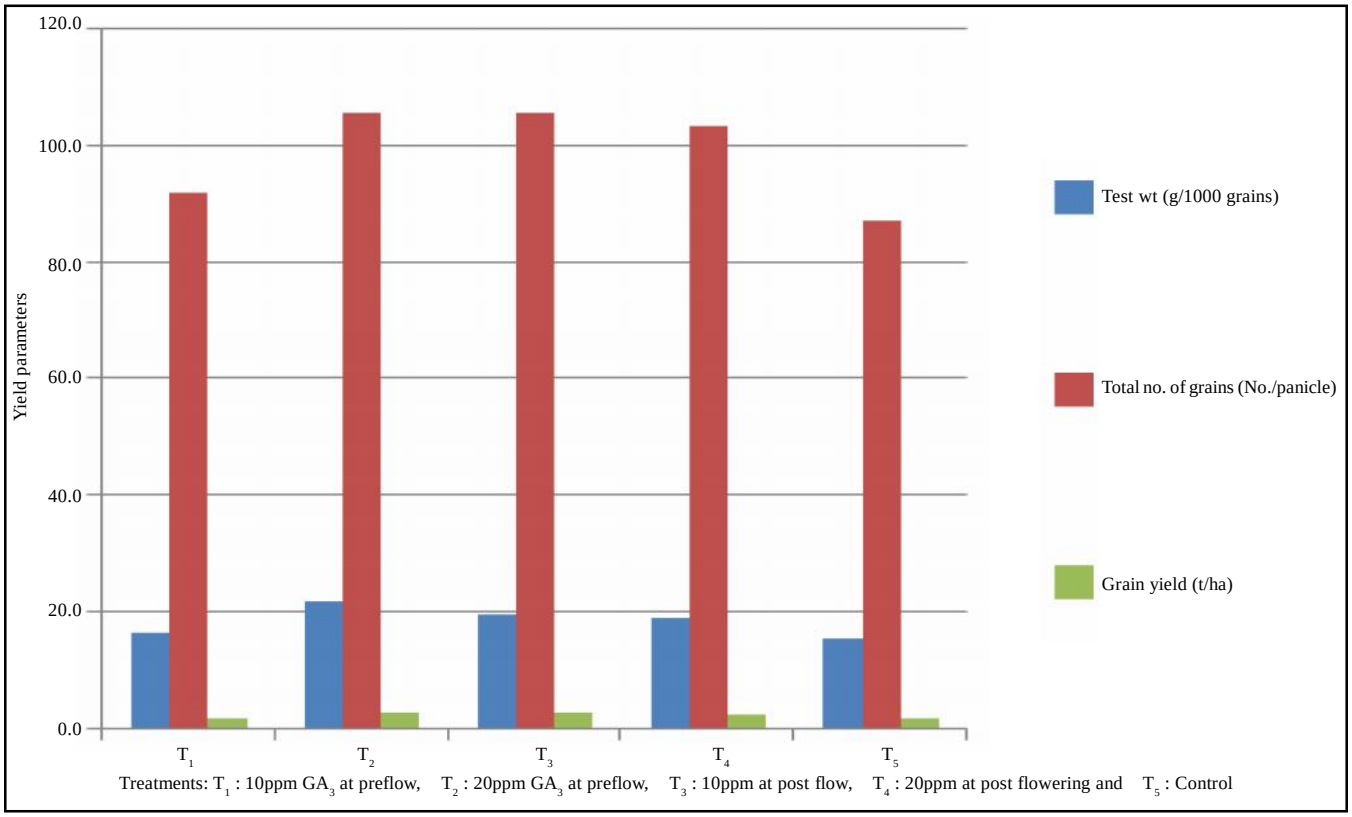

Fig. 1: Effect of GA_3 on test wt, total number of grains per panicle and grain yield of KRH-2 hybrid rice seed production

Similar results were quoted by Virmani and Sharma (1993), where in GA_3 was also used to increase the duration of floret opening, the rate of stigma exertion, lengthen the duration of stigma receptivity and adjust the plant height of both parents, and increase the growth rate of secondary and tertiary tillers so that they bear panicles.

The number of filled grains (No. / panicle) was highest in T_2 (82.0) followed by T_3 (77.50). It was also similarly coated by Michael and Sunday (2005). The effect of GA_3 on panicle peduncle is to change the intracellular concentration of solutes, which causes the osmotic influx of water into the cell resulting in increased turgor. Plant cells may expand as a response to an increase in turgor pressure against which was proven and a successful approach in significant increased in seed yield in China, in hybrid rice seed production. Similarly number of tillers per Mt^2 was counted and it ranged from 320.3 to 444.0 (T_5 and T_3) treatments, respectively.

GA_3 applied 20 ppm during pre flowering stage was increased yield of 50 per cent in female line of KRH-2 hybrid seed production (T_2) compared to control and the number of filled grain per panicle observed were ranged from 87 to 105.5 and similar result was obtained by Suge (1990). Ponnuswamy *et al.* (1998), found an

increasing proportion in seed yield by applying GA_3 which significantly increasing yield of CMS line IR58025A by a maximum of 80, 20 and 77 per cent, respectively at 150 g ha^{-1} dosage.

GA_3 application was very effective in increasing seed set rate and seed yield through elongation of plant height, promoting panicle and spikelet exertion, enhancing stigma exertion, test weight, number of filled grains per panicle, longevity and receptivity (Fig. 1). During the 2011 wet season in the ARS, Dadesugur 20 ppm dosage of GA_3 at pre flowering stage was found the most effective and economical for hybrid rice seed production.

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REFERENCES

Biswas, S.K. and Choudhury, N.H. (1981). The nitrogen and mineral contents of paddy strew. Proc. of seminar on maximum livestock production from minimum land. Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 88-96.

Biswas, K.K. and Medi, A. (1994). Influence of plant senescence as modified by hormones and nutrients on yield of rice. *Indian J. Plant Physiol.*, **24** : 1-5.

Bidwell, R.G.S. (1974). *Plant Physiology*. Macmillan, NEW YORK, U.S.A.

Duan, X.M. and Ma, H.S. (1992). Effect of gibberellic acid application on sed yield of and quality of hybrid rice. *Seed Sci. & Tech.*, **29** : 209-214.

Godai, N. and Barhuah, K.K. (2000). Effect of cold hardening and GA_3 on growth and yield of Boro rice. *Indian J. Plant Physiol.*, **5**(4) : 15-18.

Ponnuswamy, A.S., Rangaswamy, M., Rangaswamy, P. and Thiyagarajan, K. (1998). Adapting hybrid rice seed production technology. *Internat. Rice Res. Notes*, **23** (2) : 23-26.

Prakash, L. and Parthapasenam, G. (1990). Interactive effect of NaCl salinity and Gibberllic acid on shoot growth, content of Abscisic acid and gibberllin like substances and yield of rice (*oryza sativa* L.). *Plant Sci.*, **100** (3) : 173-181.

Suge, H. (1990). Survey of gibberellins in rice lines having dwarfing genes and in auto tetraploid lines. *Jpn. Breed*., **40** (1) : 21-31.

Virmani, S.S. and Sharma, H.L. (1993). *Manual for hybrid rice seed production*. Manila, Philippines, IRRI.

Virmani, A.K., Tsou, J.A., Siegmund, K.D., Shen, L.Y., Long, T.I., Laird, P.W., Gazdar, A.F. and Laird-Offringa, I.A. (2002). Hierarchical clustering of lung cancer cell lines using DNA methylation markers. *Cancer Epidemiol Biomarkers Prev.*, **11**(3) : 291-297.

Yuan, L.P. (1985). A concise course in hybrid rice. Human Technology Press, Changsha, China

Yuan, L.P., Virmani, S.S. and Khush, G.S. (1985). Wei You 64- an early duration hybrid for China. *IRRN*, **10**(5): 11-12.

■ WEBLIOGRAPHY:

Michael, R. and Sunday, C. (2005). Effect of exogenous giberellic acid (GA_3) application on stem elongation in wild-type and ros/ros mutants of *Brassica campestris*. Retrieved February 10, 2006, from *http://www.sfu.ca/~msr/Papers/BISC/brassica.html.*