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*Short Communication*

# Nursery fertilization of parental line seedlings for optimizing seed set and yield in hybrid rice CORH2

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In India nearly 65 per cent of the people depend on rice for their daily food. By the year 2020, the earth will home to 8 billion people and 40 per cent of them will be rice consumers. In due course, India must increase its rice production by a minimum of 70 per cent to feed the growing population. Among the various possible genetic approaches available, to break the yield barriers in rice, hybrid rice has proved to be the most feasible. The adoption of the hybrid rice technology by the farmers would depend upon the availability of quality seed at affordable cost. This may be achieved by a technology which can enhance and optimize hybrid seed production per unit area. Proper nutrient management of parental lines in the nursery will reflect on crop growth in the main field. Early findings suggested that healthy and vigorous seedlings with desirable seedling characters could be obtained in nursery manuring [1]. The parental lines nursery of hybrid rice, where the plant density is too high, the competition for nutrient becomes obvious. Nitrogen is a main growth element and phosphorus for better root development. The level of fertilizer applied to the crop in nursery and in development stage is one of the approaches to regulate the physiological and biochemical proportions of the resulting seed for progeny performance [2]. Healthy and vigorous seedlings with higher dry matter content can be produced from nursery with nitrogen fertilization and the initial dry matter and carbohydrate content of young seedlings are believed to help better plants establishment [3]. Application of phosphorous to the rice nursery greatly influences rooting and promotes early root growth in the soil by increasing the nutrient uptake by seedlings [4]. According to Senthilkumar [5] higher yield in hybrid rice could be obtained with higher dosage of nitrogen applied to the nursery. Hence, knowledge on competitive role of nursery fertilization to the parental lines' seedlings to maximize seed set and yield in CORH 2 was studied.

Studies were undertaken during two *rabi* seasons in the North-west agro-climatic zones of Tamil Nadu, India. The parental lines *viz.* IR 58025A and C 20 R of rice hybrid CORH 2 were obtained from Department of Rice, TNAU, Coimbatore, India. The seeds of parental lines were first dried to 12% mc, cleaned and then graded with suitable sieves, treated with fungicides and utilized for the present study. The experimental site is situated at 11° N latitude, 70°E longitude and an altitude of 426.72 M above mean sea level. The soil was low in available nitrogen (229 kg N $ha^{-1}$), medium in available phosphorous (36.2 kg $P_2O_5$ $ha^{-1}$) and high in available potassium (543 kg $K_2O$ $ha^{-1}$) and contains deficient amount of available Zinc (< 1.2 ppm) and sufficient amount of available iron, copper and manganese. **Nursery trial** experiment was laid out in a randomized block design with four replications of fourty eight raised beds of 2 x 2 m each. The individual beds were perfectly leveled. The experimental plots were applied with six treatments (Table 1). Pre-

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germinated (the seeds were soaked uniformly in equal volume of water for 12 hr, according to the treatment schedule and the seeds were incubated in a dark room for 24 hr); seeds of both A and R lines were treated with *Azospirillum* and shade dried for 30 min before sowing. Then the seeds @100 g per 4 $m^2$ for each A and R lines were sown with a basal dose of DAP @0.2 kg per 4 $m^2$ to all the plots, irrespective of treatment. As per the treatment schedule the $K_2O$ in the form of muriate of potash (MOP) was applied as basal. N in the form of urea was applied on 7 and 14 days from sowing. To observe biometric characters of both A and R line seedlings, a sample consisting of 10 seedlings was selected at random from each replication of all treatments; the root and shoot length, dry matter production, total number of tillers, root volume, total nitrogen content [6], soluble protein [7], total root ATPase activity [8] and chlorophyll content [9] were measured on 18, 22 and 25 days from sowing (DFS), and the treatment significance at 5% level was worked out [10]. **Field trial** experiment was designed in randomized block design with four replications. 18, 22 and 26-days-old A and R line seedlings from significantly superior treatment of nursery experiment were transplanted as per the recommended practice for hybrid rice seed production. The biometric observations *viz.* days to flowering, number of total and productive tillers, panicle length, plant height, number of spiklets per panicle were recorded invariably in randomly selected ten hills in each replication. Besides, the hybrid seed set percentage and yields were recorded, and the treatment significance at 5% level was worked out [10].

In the present study, increased rate of N application @150 kg $ha^{-1}$, as top dress, in two equal split doses + K @60 kg $ha^{-1}$ applied as basal in addition to recommended nursery fertilizer application ($T_6$) was superior in registering the maximum root and shoot length at all the stages of seedling growth in both A and R lines. It produced the maximum root and shoot length with 25.5 and 19.2 per cent increase over the control ($T_1$) in A line. The similar trend was obtained in R line. The results were in accordance with the findings of Sucharita and Boopathi [4]. Similarly it recorded 66.1 and 62.7 per cent more of dry matter production in A and R lines, respectively over the control. The total tillers and root volume followed the similar trend. Nitrogen content at all stages of seedling growth found higher in both A and R lines due to nursery fertilizer application. Soluble protein content and total root ATPase activity increased with increased seedling age. 29.25 and 29.7 per cent more soluble protein was recorded in $T_6$ over the control in A and R lines, respectively. Similarly, it recorded 13.0 and 8.5 per cent increase of total root ATPase in A and R lines than control. Chlorophyll (a, b and total) contents at all stages of seedling growth in both A and R lines showed the similar trend. The results were corroborated with the findings of Srivastava *et al.* [11] and Venanzi *et al.* [12].

Planting of aged seedlings (26-days-old) delayed 5 and 50 per cent flowering as compared to planting of younger seedlings (18-days-old) in hybrid seed production. Seedlings transplanted on 18 days from sowing came to flower (5 and 50 per cent flowering) 5 days earlier than aged seedlings

**Table 1. Details on nursery nutrient management**

| Code | Treatment |
|---|---|
| $T_1$ | DAP @2 kg $cent^{-1}$ (basal) + *Azospirillum* as seed treatment @600 g $ha^{-1}$ (Control) |
| $T_2$ | $T_1$+ $GA_3$ @200 ppm as seed soaking for 12 hr |
| $T_3$ | $T_1$+ K @60 kg $ha^{-1}$ (basal) |
| $T_4$ | $T_3$+ N @50 kg $ha^{-1}$ as top dress in two equal split doses on 7 and 14 DFS |
| $T_5$ | $T_3$+ N @100 kg $ha^{-1}$ as top dress in two equal split doses on 7 and 14 DFS |
| $T_6$ | $T_3$+ N @150 kg $ha^{-1}$ as top dress in two equal split doses on 7 and 14 DFS |

(26-days-old). Days to 5 and 50 per cent flowering showed no response to nursery fertilization and interaction between seedling age and nursery fertilization. Plant height, total and productive tillers, panicle length, panicle exsertion and number of spikelets per panicle were significantly higher with transplanting of 18-days-old seedlings and nursery fertilization. Planting of 18 days old seedlings obtained from nursery fertilized with 150 kg N $ha^{-1}$, as top dress, in two equal split doses + K @60 kg $ha^{-1}$ as basal in addition to recommended nursery recorded higher seed set (37.29 %) and seed yield (262.63 g $m^{-2}$) than 26-days-old seedlings.

In the present investigation, increased shoot and root length, production of more number of tillers per seedling and root volume might have contributed in increased dry matter production of seedlings [13]. Application of phosphorous and nitrogen to the nursery produced vigorous roots with high dry matter production and thus, might have increased the root volume. Seed treatment with *Azospirillum* have contributed in increasing shoot length as it increased the α-amylase activity by secretion of gibberellins resulted in enhanced seedling length [14]. *Azospirillum* treated seeds produced vigourous seedlings with thick roots associated with additional root hairs with lateral root development resulting in increased N uptake and thus, might have increased N content of seedlings [15]. The higher soluble protein content in seedlings is due to higher nitrogen content in the seedlings at all growth stages [16] and thus, increased the chlorophylls in chloroplasts [17], which have increased the soluble protein content of seedlings. *Azospirillum* seed treatment induced the uptake of N, P and K resulted in increased growth of seedlings [16] and thus, might have increased the soluble protein content of seedlings. The present finding was in line with the reports of Niranjan *et al.* [18], who found positive change in total protein contents due to dual inoculation of biofertilizers to seedlings. Increase in total root ATPase activity might be attributed to increase rate of N application combined with potassium to the nursery. Nitrogen induces the cytokinin production in the roots [19] which will act as a promotor of protein synthesis and as inhibitor of protein degradation resulted in higher protein content ($g^{-1}$ of fresh tissue). Thus, higher dose of N application might have promoted the total root ATPase activity by increasing the cytokinin dependent proteins. This finding was in agreement with Kuiper *et al.* [20].

The higher plant height might be due to early establishment of younger seedlings which in turn might have higher photosynthetic capacity. It could be attributed that nursery fertilized with increased rate of N produced vigourous seedlings with increased shoot and root length, higher dry matter production and root characteristics [21] and this beneficial effect might have been continued in the main field too. The production of less number of total and productive tillers by the aged seedlings resulted in restricted growth caused by the manifestation of anatomical changes, like reduced cell division & elongation, and reduced absorption of nutrients [22]. Transplanting of very young seedlings (Usually 8 -12 days) fertilized with higher dose of N preserves a potential for tillering and rooting, increased the uptake of nutrients resulted in higher photosynthetic efficiency during the growth period and allocate more assimilates to the spikelets and that is reduced in transplanting of aged seedlings [23, 24].

The higher seed yield attributing characters, seed set and yield is due to early release of planting shock [25], early recovery of seedlings in the main field [26] and better growth due to increase nutrient uptake favoured the photosynthesis resulting in accumulation of higher photosynthates, early panicle emergence, higher panicle length and more number of spikelets per panicle and thus, might have contributed to increase in seed set and seed yield in transplanting of younger seedlings. This is supported with the result of Bassi *et al.* [27] and Krishna [28].

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