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Yield maximization of rice under *rabi* season through physiological manipulation

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SUMMARY

The effect of foliar application of plant growth regulants such as brassinolide, mepiquant chloride, salicylic acid, triacontenol, humic acid and seaweed extract of *Sargassum* sp. on rice was observed in *rabi* season. The results revealed that among the treatments sea weed extract and brassinolide brought about significant increases in yield through favourably modifying morpho- physiological characters.

Key words : Rice, *Rabi* season, Plant growth regulators, Yield

Rice is the major cereal crop in South East Asia, which is grown under two seasons, namely, *kharif* and *rabi.* Its productivity level could not be maintained because of significant control exercised by seasons. When compared to rice grown under *kharif* season, the yield of *rabi* season rice is much lower and this could be attributed to lower level of solar radiation and decreased temperature pertaining during *rabi* season. Previous studies have also indicated lower yields in rice under *rabi* season as a consequence of decreased photosynthesis, which led to lower biomass productivity (Tanaka *et al.*, 1964). Under low light conditions, the crop suffered higher sterility, which accounted for low yield levels during *rabi* season. Besides, the plants also exhibited taller stature (Stansel *et al.*, 19565). With a view to increasing the productivity of rice under *rabi* season, an attempt was made using plant growth regulator and other chemicals for enhancing the yield potential. In an experiment conducted during the period 2003-05.

MATERIALS AND METHODS

A study was conducted at the experimental fields of the Agricultural College and Research Institute of Tamil Nadu Agricultural University at Madurai during the period 2003-05. The field trial was laid out in a Randomized Block Design and the treatments consisted of foliar spray of the following chemicals at pre-flowering phase of the crop:

– Brassinolide (0.3 ppm),
– Mepiqnat chloride (125 ppm),
– Salicylic acid (125 ppm),
– Triacontrol (100 ppm),
– Humic acid (1 %)
– Seaweed extracts (5.0 %).

The soil of the experimental field was clay loam with available N, P and K being 265.0, 12.2 and 310.0 kg/ha and, respectively. Twenty five days old seedlings of the rice variety, ADT 39, were transplanted at the rate of 2-3 seedlings per hill at a spacing of 20 x 10 cm. The recommended package of cultivation practices was carried out. The physiological and yield parameters were recorded in each of the treatment plots.

RESULTS AND DISCUSSION

The results of the experiment clearly indicated the positive influence of chemicals applied to the plants through foliar spray (Table 1). Among the various treatments imposed, brassinolide (0.3 ppm) followed by sea weed extract (2.5%) brought about significant increase in leaf area index (LAI) and leaf area duration (LAD). The positive impact of these two chemical substances was already confirmed in previous studies. The increased source site as reflected by higher LAI and LAD led to greater DMA under these treatments.

Besides brassinolide, seaweed extract effectively enhanced the total chlorophyll content (3.24 mg/g) and photosynthetic rate (38.5 mg CO2 dm^{-2} h^{-1}).These results are in accordance with the reports of earlier studies (Gandhiyappan and Perumal, 2001).The Plants that received the foliar spray of sea weed extract registered higher grain yield of 3466 kg ha^{-1}. The brassinolide treatment also was equally effective in significantly improving the yield.

The lowest grain yield (2990 kg/ha) was recorded under untreated control plots. The maximum yield achieved under seaweed extract could be explained by the higher level of performance in growth as well as

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Table 1 : Effect of growth regulant chemicals on physiological and yield parameters of rice under *rabi* season

Treatments	LAI	LAD (days)	DMA ($g.pl^{-1}$)	Chlorophyll content (mg/g)	Photosynthetic rate (mg CO_2 dm^{-2} h^{-1})	1000-grain weight (g)	Grain yield (kg/ha)	Harvest Index (%)
Brassinolide (0.3 ppm)	5.21	96.52	1221	3.12	37.51	21.37	3466	30.10
Mepiquat chloride (125 ppm)	4.19	79.90	1098	2.85	33.67	18.05	3106	28.17
Salicyclic acid (125 ppm)	4.45	81.06	1067	2.76	31.06	17.94	3125	28.50
Triacontenol (100 ppm)	4.52	82.35	1051	2.80	30.71	18.01	3214	28.75
Humic acid (1.0%)	4.90	85.01	1078	2.82	31.15	18.12	3207	29.10
Sea weed extract (2.5%)	5.05	92.76	1235	3.24	38.05	21.23	3496	30.19
Water spray	4.25	79.64	1038	2.60	29.98	17.10	3015	28.00
Control (No spray)	4.21	78.17	1030	2.38	29.84	16.83	2990	27.74
S.E.±	0.12	1.22	6170	0.11	1.59	1.25	141.70	0.91
C.D. (P=0.05)	0.23	3.01	139.25	0.23	3.24	2.78	260.33	1.69

physiological attributes. Earlier studies using the sea weed extract of *Sargassum* sp. in yield improvement trials also highlighted its efficacy in raising the yield potential in other crop plants (Anandaraj and Venkatasalam, 2001).

The reason for its ability to enhance the productivity level of crops could be explained by its higher levels of phytohormones especially cytokinin and gibberellins as also a large amount of trace elements. Use of sea weed extracts in the improvement of yields in other crops such as pulses has also been reported (Nuray Ergun *et al.*, 2002). The *rabi* season is usually characterized by prevalence of lower temperature and low light intensity conditions. These factors led to a reduction in the uptake of major as well as minor nutrients from the soil by the crop.

When the plants received additional source of nutrients from foliar spray of sea weed extract it compensated the reduction in the absorbed nutrients from the soil. There were several studies which brought out the production of both macro and micro nutrients in the sea weed, *Sargassum* sp. (Murugalakshmi *et al.,* 2003). Besides acting as the source of nutrients, sea weed also provided a continuous supply of phytohormones such as gibberelin and cytokinin. These factors explained the higher amount of growth and yield in the plants treated with sea weed extract. Thus it could be concluded that the adverse impact of unfavourable climatic factors on the *rabi* season rice causing a drastic reduction in the grain yield could be overcome to a greater extent through the use of growth regulating substances and sea weed extract as proved in the present investigation.

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