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Yasmeen Begum
Department of Crop Physiology, and Plant breeding College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

RP Patil
Department of Crop Physiology, and Plant breeding College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

MK Meena
Department of Crop Physiology, and Plant breeding College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

A Amaregouda
Department of Crop Physiology, and Plant breeding College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Mahantashivayogayya
Department of Genetics and Plant breeding, College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Correspondence
Yasmeen Begum
Department of Crop Physiology, and Plant breeding College of Agriculture, University of Agricultural Sciences, Raichur, Karnataka, India

Influence of different agrochemicals on morphological and yield traits of rice (*Oryza sativa* L.) grown under northern dry zone of Karnataka

Yasmeen Begum, RP Patil, MK Meena, A Amaregouda and Mahantashivayogayya

Abstract
A field experiment was conducted at Agricultural Research Station, Gangavati, University of Agricultural Sciences, Raichur, Karnataka to study the influence of different agrochemicals on morphological parameters and yield and yield components of rice variety GNV10-89. The experiment was laid out in randomized complete block design with 3 replications during *kharif* season 2017. The experiment consisting of 10 different agrochemicals treatment along with a control *i.e.*, T_1: 25 % extra nitrogen (N) soil application, T_2: NPK (19:19:19) @ 1.0 %, T_3: triacontanol (2.0 ml l^{-1}), T_4: GA_3 (50 ppm), T_5: nitrobenzene (20 ppm), T_6: salicylic acid (500 ppm), T_7: 6-BAP (20 ppm), T_8: borax (0.2 %), T_9: T_3 + T_8 foliar applications and T_{10}: control. The results indicated that the analysis of variance was significant for all the morphological characters except unproductive tillers by foliar as well as soil application of different agrochemicals at 65 (10 days before panicle initiation) and 85 days after transplanting (10 days after panicle initiation). The treatment T_2 (NPK- 19:19:19 @ 1.0 %) recorded the significantly higher number of productive tillers per hill (17.4), more number of green leaves per hill (69.8), less number of senescent leaves per hill (7.7) and higher flag leaf length (43.7 cm) except plant height (98.2 cm). The significantly higher plant height (130.5 cm) was recorded by foliar spray of T_4 (GA_3-50 ppm) as compared to other treatment. T_2 (NPK -19:19:19 @ 1.0 %), recorded the significantly higher grain yield (8709.8 kg ha^{-1}) than rest of the treatment.

Keywords: agrochemicals, foliar and soil application, morphological traits, yield and yield components

Introduction
Rice (*Oryza sativa* L.) is an important cereal crop of developing countries and also the staple food for over half of the world’s population. It is a "Global grain" cultivated widely across the world and feeds millions of mankind. Asia is considered as "Rice Basket" of the world, as 90 per cent of world's rice is grown and consumed with 60 per cent of population and where, about two-third of world's poor live (Khush and Virk, 2005) [14]. Merely 4 to 5 per cent of world rice production enters the global market. Hence, any shortfall in rice production especially in the major rice growing countries could be disaster for food security. Rice occupies the prime place among the food crops cultivated around the world which supplies adequate energy and is a good source of thiamine, riboflavin and niacin (Stalin *et al*., 2011) [27].
India is representing the first largest area and second largest production in the world (Anon., 2017) [3]. The food demand of the country is increasing day by day due to rapid population growth. The total cultivable area on the contrary is decreasing therefore, to bridge the gap between these two and to meet up the need for food, one of the avenues is to use different agrochemicals to produce major changes in the growth, yield and productivity. In Karnataka, rice is cultivated in command areas of Cauvery, Tungabhadra and Upper Krishna. The total area under rice cultivation in Karnataka is 1.52 m ha, with an annual production of 3.74 m t and the productivity is 3.28 tonnes per ha (Anon., 2017) [3].
There are so many limitations in rice production one of them is chaffyness character of rice due to adverse climatic conditions and also imbalance between the source and sink may be due to lack of photosynthates production or in-efficient translocation of reserve food to sink region. Plant growth regulators play vital roles in coordination of many growth and behavioral processes in rice, which regulates the amount, type and direction of plant growth (Rajendra and Jones Jonathan 2009; Anjum *et al*., 2011) [22, 2]. This variety selected from the cross between GGV-05-01 x NES-07-03.

Salient features of this variety as follows: it is a dual season (*kharif* and *summer*), high yielding, early and medium slender variety. The specialty of GNV10-89 variety is maximum number of spikelets up to 350 per panicle but normally we can observe 250 spikelets per panicle in other varieties *viz.*, Sona Masoori and Kaveri Sona which are also popular varieties in this region. But the problem found in GNV10-89 is 35 per cent of spikelets are unfilled *i.e.*, chaffy grains it might be due to inefficient translocation of reserve photosynthates to the reproductive parts of the plant.

Material and Methods

A field experiment was carried out at Agricultural Research Station (ARS), Gangavati, UAS, Raichur, during *kharif* 2017 to study the influence of different agrochemicals on morphological parameters, yield and yield attributes of rice variety GNV10-89. The experimental site is situated in the Northern Dry Zone of Karnataka between 15'15'40" North latitude and 76'31'40" East longitude at an altitude of 419 meter above mean sea level. The experiment was laid out on medium black soil and the status of the soil indicates low in available N, medium in available P_2O_5 and high in available K_2O.

The experiment was laid out in a randomized complete block design with 3 replication with and 10 treatment including control. The first treatment imposition was done at 10 days before panicle initiation (65 Days after transplanting) as the varietal character showed panicle initiation starts from 75 to 80 days after transplanting and second treatment imposition was at 10 days after panicle initiation (85 Days after transplanting). The foliar as well as soil application of different agrochemicals where RDF (NPK 150:75:75 kg ha^{-1}) was common for all the treatment. The following treatments: T_1 - 25 % extra N soil application as top dressing, T_2 - Foliar application of NPK (19:19:19) @ 1.0 %, T_3 - Foliar application of triacontanol (2.0 ml/l), T_4 - Foliar application of GA_3 (50 ppm), T_5 - Foliar application of nitrobenzene (20 ppm), T_6 - Foliar application of salicylic acid (500 ppm), T_7 - Foliar application of 6-BAP (20 ppm), T_8 - Foliar application of borax (0.2 %), T_9 - Foliar application of T_3 + T_8 and T_{10} - Control.

Observations with respect to morphological traits were recorded at 10 days after treatment imposition *i.e.*, 95 days after transplanting. The data on following morphological parameters were recorded *viz.*, plant height, number of productive tillers per hill, unproductive tillers per hill, total number of tillers per hill, number of green leaves per hill, number of senescent leaves per hill, flag leaf length; yield and yield attributing parameters *viz.*, panicle length, panicle weight, number of spikelets per panicle and yield. Comparisons were made using one-way analysis of variance (ANOVA) as given by Panse and Sukhatme (1985) [20].

Results and Discussion

The results obtained from the experiment include various morphological parameters *viz.*, plant height, number of productive tillers, number of unproductive tillers, total number of tillers per hill, number of green leaves, number of senescent leaves per hill and flag leaf length was determined the data related to the morphological parameters are given in Table 1. The highest plant height (130.5 cm) was recorded by foliar spray of T_4 (GA_3-50 ppm) over rest of the treatment besides the significantly lower plant height (82.7 cm) was recorded in T_{10} (control) (Figure 1). These results are in accordance with that of Gavino *et al.* (2008) [9] in rice followed by Li and Yuan (2000) [16], Kothule *et al.* (2003) [15], Viraktamath (1993) [29], Elankavi *et al.* (2009) [8], Jagadeeswari *et al.* (2004) [11], Dunand (2005) [7] and Virmani *et al.* (2007) [30]. Who reported that the increase of plant height following GA_3 treatment was due to its positive effect on elongation of cells led to increase in the plant unproductive tillers based on the panicle emergence and grain filling percentage. Among the different agrochemicals the treatment T_2 (NPK- 19:19:19 @ 1.0 %) recorded higher number of productive tillers per hill (17.4) and lower number of unproductive tillers per hill (0.7) over rest of the treatment. Whereas, T_{10} (control) recorded less number of productive tillers per hill (11.5) and foliar spray of T_6 (salicylic acid- 500 ppm) recorded more number of unproductive tillers per hill (2.8) than other treatment. Similar findings have also been obtained by Shaiful *et al.* (2009) [25] and Manzoor *et al.* (2006) [17]. Who found that the higher number of tillers was produced at 65 days after transplanting of rice when urea was applied in three equal splits whereas, at 90 days after transplanting the lowest number of tillers was produced when urea was applied as full dose without split reported by Palchamy *et al.* (1989) [18] and Jayakumar *et al.* (2004) [13]. The foliar spray of NPK significantly increased the number of branches per plant in common bean reported by Rahman *et al.* (2014) [21] followed by Venkatareddy (2006) [28] in soybean. The foliar spray of 19:19:19 (NPK) 2 per cent recorded maximum number of branches in soybean (Dandge *et al.*, 2018) [5].

With respect to number of green leaves the significant difference was observed between foliar spray and soil application of different agrochemicals. The number of green leaves decreased as the growth advanced might be due to ageing up of the leaves (Figure 2). At this stage the highest (69.8) number of green leaves was recorded in T_2 (NPK- 19:19:19 @ 1.0 %) followed by T_7 (6-BAP- 20 ppm) 63.4 than other treatment. The lower (24.7) number of green leaves was noticed in T_{10} (control). These results are in conformity with the findings of Ali *et al.* (2014) [1]. Who revealed that it might be due to combined application of growth regulators *i.e.*, BA (cytokinin) reduces the ageing of leaves and maintains greenness of leaves for longer period.

The number of senescent leaves was increased progressively as the advancement of the growth. Senescent leaf number per hill was differed significantly in all the treatments. The significantly higher (36.3) senescent leaf number was recorded in control. Though, T_2 (NPK- 19:19:19 @ 1.0 %) showed significantly lower (7.7) senescent leaf number (Figure, 3). The plant growth regulators certainly help to prevent the abscission of leaves, flowers and pods in soybean, when applied at the time of flowering (Ramesh and Thirumuguran, 2001) [23]. The leaf senescence starts earlier before completion of maturity which break the source to sink relation, thereby reduces the yield. Nitrogen foliar applications have been found to delay leaf senescence and improve yield. Palta *et al*. (2005) [19] and Zeidan (2003) [31] who concluded that foliar application of urea at 50 per cent flowering increased the yield in legumes.

Among the treatment foliar spray of T_2 (NPK- 19:19:19 @ 1.0 %) recorded the significantly higher (43.7 cm) flag leaf length when compared with left over treatment. The lower (26.3 cm) flag leaf length was noticed in T_{10} (control). Foliar spray of T_4 (GA_3- 50 ppm) recorded higher (32.3 cm) flag leaf length than T_{10} (control). The results were found similar with that of Srivastava *et al.* (1979) [26], Rao (1992) [24] and Jagadeeswari (2001) [10] who reported that foliar application of GA_3

elongates the cells in the upper side of the leaf at collar region which facilitates flattening of the flag leaf thus allowing better movement of pollen ultimately directed to higher yield.

The yield and yield attributing parameters are given in the Table 2 and Figure 4. Panicle length, panicle weight and number of filled spikelets per panicle are considered as the principle yield contributing characters. The significantly higher panicle length (25.4 cm), panicle weight (44.5 g hill^{-1}) and number of filled spikelets per panicle (232.9) was recorded in the treatment T_2 (NPK- 19:19:19 @ 1.0 %) as compared to rest of the treatment. The lower panicle length (12.0 cm), panicle weight (20.7 g hill^{-1}) and number of filled spikelets per panicle (172.7) was observed in T_2 (control). Panicle length and number of grains per panicle were increased due to increase in the concentration of nitrogen fertilizer. Therefore, the panicle length (29.75 cm) and number of spikelets per panicle (130.2) was higher at 225 kg N ha^{-1} reported by Manzoor *et al.* (2006) [17].

The carbohydrates in rice grains originate from photosynthesis that is carried out predominantly in leaves (sources). Therefore, grain filling and rice yield depend on the efficient transport of carbohydrates from the leaves to seeds (sinks). In most plants, sucrose is the main carbohydrate transported long distance in the veins to support the growth and development of roots, flowers, fruits, and seeds. The data on grain yield indicated that the treatment T_2 (NPK- 19:19:19 @ 1.0 %) recorded the significantly higher (8709.8 kg ha^{-1}) yield as compared to all other treatment. However, the significantly lower (7080.3 kg ha^{-1}) yield was recorded in T_{10} (control) and rest of the treatment was differed significantly. These results are in conformity with the findings of Dakshina *et al.* (2014) [4]. Who reported that higher dose of major nutrients (NPK) might have facilitated to increase grain yield. The foliar spray of NPK was the suitable application for maximum yield of blackgram (Rahman *et al.*, 2014) [21] and Das and Jana (2015) who also reported the effect of water soluble fertilizer NPK (19:19:19) spray on growth and yield of pulses showed the significantly higher seed yield.

Conclusion

The present study revealed that foliar and soil application of different agrochemicals in addition to recommended dose of fertilizers has increased the yield components *viz.*, panicle length, panicle weight, number of filled spikelets per panicle due to which there was increase in the final grain yield of rice variety GNV10-89. This increment might be due to boost in the morphological characters such as plant height, number of productive tillers, number of unproductive tillers, number of green leaves, reduced number of senescent leaves and increased flag leaf length.

Table 1: Effect of different agrochemicals on morphological traits at 95 days after transplanting of rice

Treatment	Plant height (cm)	Productive tillers hill^{-1}	Unproductive tillers hill^{-1}	Green leaves hill^{-1}	Senescent leaves hill^{-1}	Flag leaf length (cm)
T_1 - 25 % extra N soil application as top dressing	103.1	15.3	1.4	57.1	16.3	37.4
T_2 - Foliar application of NPK (19:19:19) @ 1.0 %	98.2	17.4	0.7	69.8	7.7	43.7
T_3 - Foliar application of triacontanol (2.0 ml/l)	94.4	13.6	2.1	44.0	24.0	33.2
T_4 - Foliar application of GA_3 (50 ppm)	130.5	13.1	2.3	47.7	25.5	32.3
T_5 - Foliar application of nitrobenzene (20 ppm)	93.8	14.2	2.6	50.1	18.7	35.1
T_6 - Foliar application of salicylic acid (500 ppm)	88.9	12.4	2.8	38.7	34.2	29.4
T_7 - Foliar application of 6-BAP (20 ppm)	97.3	16.5	0.9	63.4	12.6	39.6
T_8 - Foliar application of borax (0.2 %)	92.6	12.7	2.1	35.3	32.0	30.8
T_9 - Foliar application of T_3 + T_8	95.5	14.2	1.4	51.9	21.4	34.1
T_{10} – Control	82.7	11.5	1.2	24.7	36.6	26.3
Mean	97.7	14.09	1.75	48.2	22.9	34.2
S.E.m (±)	0.90	0.74	0.70	2.30	0.80	0.78
C.D. at 5 %	2.70	2.19	NS	6.90	2.40	2.34

N-Nitrogen, GA_3- Gibberellic acid, 6-BAP – Benzylaminopurine, NS- Non-significant

Table 2: Effect of different agrochemicals on yield and yield attributes of rice

Treatment	Panicle length (cm)	Panicle weight (g hill^{-1})	Filled Spiklets panicle^{-1}	Grain yield (kg ha^{-1})
T_1 - 25 % extra N soil application as top dressing	21.2	39.3	231.2	8419.9
T_2 - Foliar application of NPK (19:19:19) @ 1.0 %	25.4	44.5	232.9	8709.8
T_3 - Foliar application of triacontanol (2.0 ml/l)	17.6	33.4	202.1	8080.0
T_4 - Foliar application of GA_3 (50 ppm)	16.7	33.2	201.7	7890.2
T_5 - Foliar application of nitrobenzene (20 ppm)	19.8	35.8	222.4	8350.1
T_6 - Foliar application of salicylic acid (500 ppm)	15.3	26.1	190.5	7540.4
T_7 - Foliar application of 6-BAP (20 ppm)	21.5	41.9	231.8	8509.9
T_8 - Foliar application of borax (0.2 %)	16.0	29.0	198.0	7730.0
T_9 - Foliar application of T_3 + T_8	18.7	35.3	203.1	8219.7
T_{10} – Control	12.0	20.7	172.7	7080.3
Mean	18.4	33.9	208.6	8053.0
S.E.m (±)	0.42	0.50	0.80	0.80
C.D. at 5 %	1.26	1.49	2.40	2.40

N - Nitrogen, GA_3- Gibberellic acid, 6-BAP – Benzylaminopurine

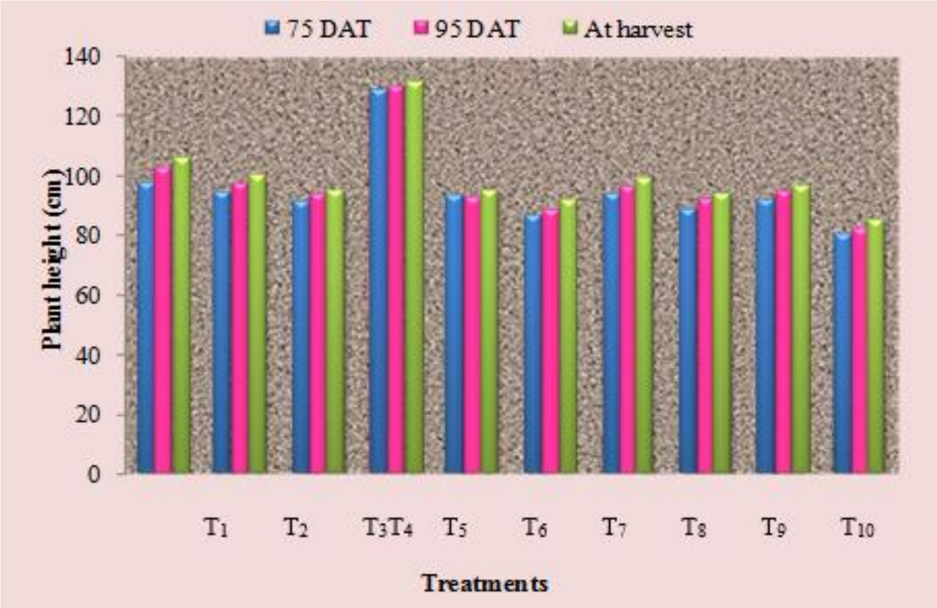

Fig 1: Effect of agrochemicals on plant height (cm) at different growth stages of rice

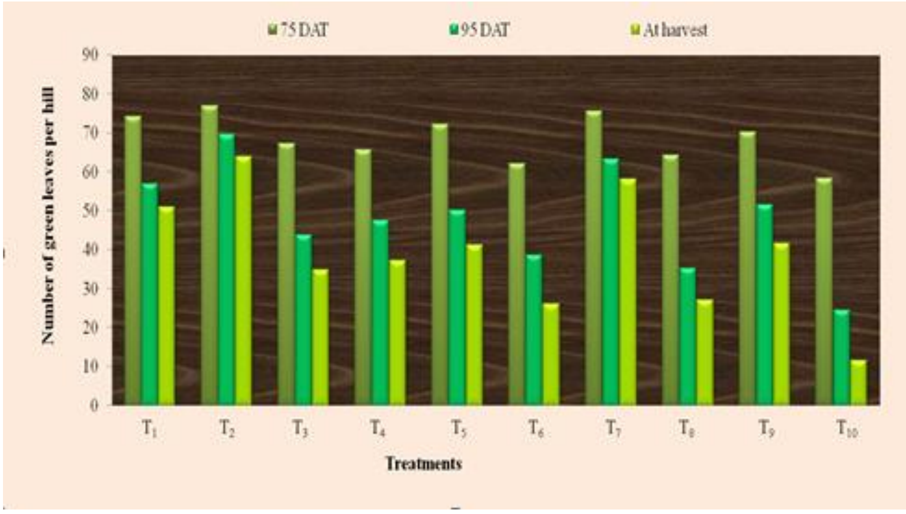

Fig 2: Effect of agrochemicals on number of green leaves per hill at different growth stages of rice

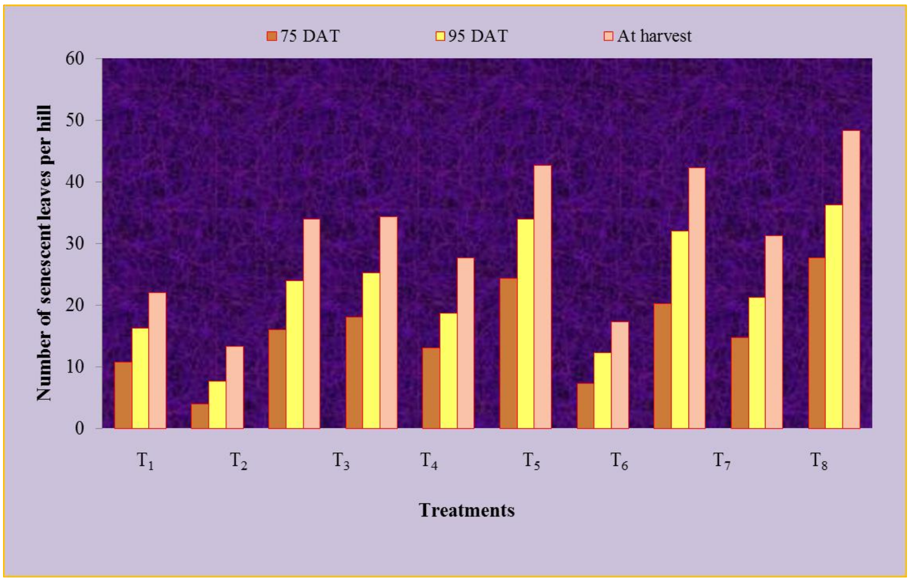

Fig 3: Effect of agrochemicals on number of senescent leaves per hill at different growth stages of rice

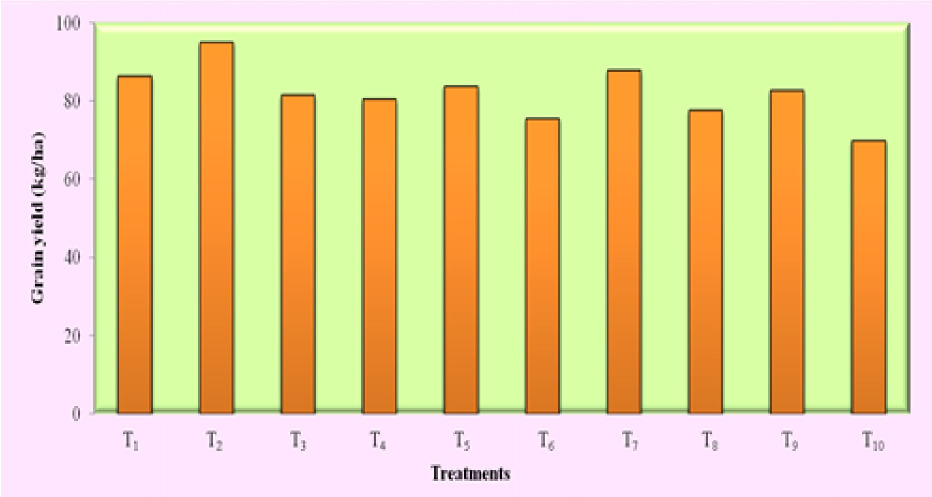

Fig 4: Effect of agrochemicals on grain yield of rice (kg ha^{-1})

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