STUDIES ON THE INTEGRATED EFFECTS OF PLANT NUTRITION AND WEED CONTROL FOR THE QUALITY PRODUCTION OF RICE (*ORYZA SATIVA* L.) IN SINDH PROVINCE OF PAKISTAN

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ABSTRACT

The current field experiments were conducted at two successive years throughout Kharif, 2017 and 2018 at Students' Experimental Research Farm, Department of Agronomy, Sindh Agriculture University, Tandojam, Pakistan. The rice variety Shandar was transplanted on 15 May 2017, after 45 days old seedling for both years. Every plot was differentiated with a 40 cm walkway and a plot size of 5m × 4m (20m^{-2}) with randomized complete block design. The results showed significant effects on weed, agronomic and physiological traits. The weed observations resulted minimum interactive values for weed density (m^{-2}) was observed with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1}× W_1 = (No weeding), minimum fresh biomass of weed (g m^{-2}) and weed dry biomass (g m^{-2}) was observed with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} ×W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1}. However, minimum weed control (0.00 %) was found with F_1 = No fertilizer (Control) × W_1 = Weedy check (No weeding). Whereas, rice observations resulted maximum interactive values for panicle length, kernels panicle^{-1}, seed index (1000 kernel wt. g), kermal yield (t ha^{-1}) and protein (%) with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1}× W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT). The maximum kernels wt. panicle^{-1} (g) was recorded with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1}× W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT). However, maximum crop growth rate (gm^{-2} day^{-1}) was recorded with F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1}× W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT). The study revealed research areas to establish adequate management practices through different levels of nutrients and weed control for the enhancement of quality Paddy (rice) production.

Keywords: Integrated management, Rice, Nutrition, Weed, Quality

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important grain crops that are eaten by more than three and half billion peoples throughout the world (CGIAR, 2016). Due to its scent, flavor, and cooking quality, fragment/ aromatic rice is favored by the majority of the human population. However, most fragment rice cultivars have modest yields and are quickly affected by environmental conditions (Paul et al., 2021). Seventeen countries in Asia and pacific, nine countries in North and South America, and eight African countries generally depend on rice as staple food; provided 20 percent respectively (Alexandratos & Jelle, 2021). Hence, it shows that paddy is the most vital staple crop for food and nutrition safety worldwide. Nevertheless, it is important food as well as value added crop in Pakistan. Whereas, known to be second major staple food crop following wheat and next largest exportable produce after cotton. It contributes about 3.1 percent of value added and 0.6 per overall cent in GDP.

Rice cultivated area recorded during 2019-20 was 3,034 million hectare which was increased by 2.9 percent as compared to 2.810 thousand hectares of 2018-19. The overall production raised by 2.9 percent to 7.410 million tons as area under crop was significantly increased, driven in part higher domestic prices and availability of inputs on subsidized rate (GoP, 2019-2020).

Among the many agronomic performances, good nutrient management may boost the yield of fragrant rice not only by providing the needed quantity of nutrients, but also by preserving the soil's health and product quality (Paul et al., 2021). For boosting up the yield, nitrogenous, phosphoric and potassium (NPK) fertilizers have very important role when used in suitable amount (Cheema et al., 2021). Addition of 200 kg ha^{-1} N helps to increases the number of tillers, plant height, leaves per plant, spike length, grains per spike, fresh and dry weight and biological yield respectively. However, it has been predicted that due to excess use of N and P, in future there will be issue of their universal deficiency, especially for P followed by zinc. Zinc is important in many aspects of life (Camilla et al., 2022). The adoption of a modern agriculture system based on high-analysis synthetic fertilizers exacerbated issues with micronutrient shortages such as boron (Subhadeep et al., 2022).

The zinc and boron deficiency is high in Pakistan soil. Wetland rice soils, light finished soils, and calcareous soils are mostly found zinc deficient (Islam et al., 2017). Zinc mostly has an vitalposition in line of auxin; dehydrogenase catalysts enactment and keep up with the ribosomal properties (Obata et al., 2015). Boron is an important nutrient form cell division and in seed arrangement of crop (Vitosh et al., 2017). Moreover, for a particular crop, the recommended doses of fertilizers ought to be founded on series of field experiments. The outcomes can be beneficial after determining the rate of utilizing financial factors and conditions to estimate the ideal dosages of manures (Rai, 2019). As a consequence, maintaining proper micronutrient levels in the soil is crucial not only for meeting plant demands and preserving agricultural output, but also for preventing nutrient build-up (Majeed et al., 2022).

Because of the abundant wetness in the rice field and the extend duration of infection, weeds may impair rice output by over 30%, causing farmers to pay 70% of their costs to control them (Robinsonet al., 2021). Weed management strategies in Pakistan are applied mainly in irrigated areas only ignoring the rainfed regions, which eventually results low production. Since in rainfed areas, rice crop already suffers due to stress conditions, therefore occurrence of weeds could accelerate the loss of moisture from the soil (Mandal et al., 2016). Therefore it is essential that weeds may be controlled so as to keep away from unnecessary utilization of crop resources. For direct cultivated paddy, it is compulsory to maintain the fields free from weeds in initial 30 days (Bisht & Ramana, 2017).

Taking into these considerable facts allied to previous findings, present study was carried out to determine the quality rice production potential in response of plant nutrition and weed management.

Materials and methods

The current field experiments were conducted at two consecutive years during Kharif, 2017 and 2018 at Students' Experimental Farm, Department of Agronomy, Sindh Agriculture University, Tandojam, Pakistan. The materials used and methodology adopted during the course of experimentation, has been discussed here briefly.

Cultural practices

The rice seed was collected from Nuclear Institute of Agriculture (NIA) Tandojam and seed rate was applied at 18 kg ha^{-1}. Other cultural practices were adopted as per the standard requirements of the crop.

Data was recorded on the following parameters.

Weed control

Weed control was determined with the help of the following formula:

$$\text{Weed control (\%)} = \frac{\text{Check weed density} - \text{Given treatment weed density}}{\text{Check weed density}} \times 100$$

Panicle length (cm)

A total of three fully developed panicles were harvested from the plants. The length of the panicle was determined by measuring its length in centimeters from its base to its apex.

Kernels panicle^{-1}

From the plants, we harvested three fully developed panicles. The length of the panicle was determined by counting the number of millimeters from its neck to its tip.

Seed index (1000– kernel weight g)

A thousand grains of rice equals that much. Each plot's seeds were recorded and weighed to determine their index.

Kernel yield (t ha^{-1})

Following threshing, winnowing, and sun drying, the individual "kilo gramme" amounts of rice yield (harvested net plot + sample plants) were recorded and then converted to tons.

The experimental details are as under:

The Experimental design = Randomized complete block design (RCBD)
Replications = Three
Net plot size = 5 m x 4 m (20 m^2)
Variety = Shandar

Treatments = Two factors (A and B)

Factor-A: Nutrient levels (F) = 4
F_1 = No fertilizer (Control)
F_2 = NPK: 160 + 80 + 80 kg ha^{-1}
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}
F_4 = NPK+ B: 160 + 80 + 80 + 1.0 kg ha^{-1}

Factor-B: Weed control practices (W) = 4
W_1 = Weedy check (No weeding)
W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT)
W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT)
W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1}+ Sorghum water extract at 25 L ha^{-1} (10 DAT)

Treatment combinations

$T_1 = F_1 \times W_1$	$T_5 = F_2 \times W_1$	$T_9 = F_3 \times W_1$	$T_{13} = F_4 \times W_1$
$T_2 = F_1 \times W_2$	$T_6 = F_2 \times W_2$	$T_{10} = F_3 \times W_2$	$T_{14} = F_4 \times W_2$
$T_3 = F_1 \times W_3$	$T_7 = F_2 \times W_3$	$T_{11} = F_3 \times W_3$	$T_{15} = F_4 \times W_3$
$T_4 = F_1 \times W_4$	$T_8 = F_2 \times W_4$	$T_{12} = F_3 \times W_4$	$T_{16} = F_4 \times W_4$

The data was statistically analyzed by using Statistix version 8.1 software (Statistics, 2006). In cases where it was essential, we used the least significant difference (LSD) test to compare the means of the various treatment and their results are interpreted as under:

RESULTS

Weed control (%)

The results for nutrient levels showed significant response to weed control (%) and minimum weed control (38.200 %) at F_4 = NPK + B160 + 80 + 80 + 1.0 kg ha^{-1}. In case of weed control practices the lowest value (0.00 %) was observed at W_1 = Weedy check (No weeding). The maximum weed control (54.65 %) was recorded at F_1 = No fertilizer (Control). In case of weed control practices the maximum weed control (72.783 %) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT).The results further indicated that the interaction of nutrients levels and weed control practices showed highly significant response for weed control (%). In interaction minimum weed control (0.00 %) was observed with F_1 = No fertilizer (Control) x W_1 =

Weedy check (No weeding) and maximum weed control (83.920 %) was recorded with F_1 = No fertilizer (Control) x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) respectively (Table 4).

Table 1. Weed control (%) of rice under the influence of nutrients levels and weed control practices

Nutrients levels	Weed control practices				Means
	Weedy check	Herbicide (2.5 L ha^{-1})	SWE (25 L ha^{-1})	Herbicide (1.25 L ha^{-1}) + SWE (25 L ha^{-1})	
F_1 = No fertilizer (Control)	0.00	75.577 AB	59.133 D	83.920 A	54.65 A
F_2 = NPK: 160 + 80 + 80 kg ha^{-1}	0.00	61.647 DE	45.833 FG	72.050 BC	44.883 B
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}	0.00	62.657 CD	42.283 FG	74.283 AB	44.806 B
F_4 = NPK + B: 160 + 80 + 80 + 1.0 kg ha^{-1}	0.00	51.793 EF	40.130 G	60.877 DE	38.200 C
Mean	0.00 D	**62.918 B**	**46.845 C**	**72.783 A**	**-**

	Nutrients levels	Weed control practices	N × W
SE	2.5062	2.5062	5.0123
LSD = 0.05	5.1183	5.1183	10.237

Panicle length (cm)

The maximum panicle length (33.34 cm) was recorded at F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} followed by (31.56 cm) was observed in F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} and the minimum panicle length (25.76 cm) at F_1 = No fertilizer (Control) .In case of weed practices the maximum panicle length (33.11 cm) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) at .followed by (31.242 cm) was recorded at W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT whereas the lowest value panicle length(26.550 cm) was observed at W_1 = Weedy check (No weeding). The results further indicated that the interaction of nutrients levels and weed practices showed highly significant response for panicle length (cm). In interaction maximum panicle length (36.73 cm) was recorded with F_3 = Soil applied NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} x W_4 = Foliar applied Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) followed by (35.56 cm) at F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} x W_4= Foliar applied W Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) Whereas, minimum panicle length was(23.56 cm) observed with F_1 = No fertilizer (Control) x W_1 = Weedy check (No weeding) respectively(Table6).

Table 2. Panicle length (cm) of rice under the influence of nutrients levels and weed control practices

Nutrients levels	Weed control practices				Means
	Weedy check	Herbicide (2.5 L ha^{-1})	SWE (25 L ha^{-1})	Herbicide (1.25 L ha^{-1})+ SWE (25 L ha^{-1})	
F_1 = No fertilizer (Control)	23.56 L	26.50 I	24.53 K	28.46 G	**25.76**

					D
F_2 = NPK: 160 + 80 + 80 kg ha^{-1}	25.56 J	30.50 E	27.63 H	31.56 D	**28.81 C**
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}	29.56 F	32.40 C	31.50 D	36.73 A	**33.34 A**
F_4 = NPK+ B: 160 + 80 + 80 + 1.0 kg ha^{-1}	27.50 H	35.56 B	29.60 F	35.70 B	**31.30 B**
Mean	**26.550 D**	**31.242 B**	**28.317 C**	**33.11 A**	-

	Nutrients levels	Weed control practices	N × W
SE	0.0495	0.0495	0.0990
$LSD_{0.05}$	0.1011	.1011	0.2022

Kernels panicle^{-1}

The results for nutrients levels showed significant response to kernels panicle^{-1}. The maximum kernels (183.67panicle^{-1}) was recorded at F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} followed by kernels(172.25panicle^{-1}) was observed in F_4 = NPK+ B 160 + 80 + 80 + 1.0 kg ha^{-1} and the minimum kernels (139.42 panicle^{-1}) at F_1 = No fertilizer (Control).In case of weed control practices the maximum kernels (191.50 panicle^{-1}) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) .followed by (172.33 panicle^{-1}) was recorded at W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT) however, the lowest value (143.92 panicle^{-1}) was observed at W_1 = Weedy check (No weeding). The results further indicated that the interaction of nutrients levels and weed control practices showed highly significant response for kernels panicle^{-1}. In interaction maximum kernels (218.67 panicle^{-1}) was recorded with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) followed by kernels (208.67 panicle^{-1}) at F_4 = NPK+ B 160 + 80 + 80 + 1.0 kg ha^{-1}x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) Whereas, minimum kernels was (126.67 panicle^{-1}) observed with F_1 = No fertilizer (Control) x W_1 = Weedy check (No weeding) respectively (Table 7).

Table 3. Kernels panicle^{-1} of rice under the influence of nutrients levels and weed control practices

Nutrients levels	**Weed control practices**				**Means**
	Weedy check	**Herbicide (2.5 L ha^{-1})**	**SWE (25 L ha^{-1})**	**Herbicide (1.25 L ha^{-1})+ SWE (25 L ha^{-1})**	
F_1 = No fertilizer (Control)	126.67 M	142.33 K	133.67 L	155.00 I	**139.42 D**
F_2 = NPK 160+ 80 + 80 kg ha^{-1}	142.33 K	168.67 F	141.33 K	183.67 D	**159.00 C**
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}	158.00 H	196.67 C	161.33 G	218.67 A	**183.67 A**
F_4 = NPK+ B: 160 + 80 + 80 + 1.0 kg ha^{-1}	148.67 J	181.67 E	150.00 J	208.67 B	**172.25 B**

Mean	143.92 D	172.33 B	146.58 C	191.50 A	-

	Nutrients levels	Weed control practices	N × W
SE	0.3773	0.3773	0.7546
$LSD_{0.05}$	0.7706	0.7706	1.5411

Seed Index (1000 kernel wt. g)

The results on maximum seed index showed that 22.492 g seed was recorded at F_3= NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} followed by (21.375 g) was observed in F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} and the minimum kernels wt. $panicle^{-1}$ (17.242 g) at F_1 = No fertilizer (Control). In case of weed control practices the maximum seed index (24.225 g) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) .followed by (23.150 g) was recorded at W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT) whereas the lowest value (15.642 g) was observed at W_1 = Weedy check (No weeding) .The results further indicated that the interaction of nutrients levels and weed control practices showed highly significant response for seed index (1000 kernel wt. g). In interaction maximum seed index (25.833g) was recorded with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} x W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT), followed by (24.867 g) at F_4 = NPK+ B 160 + 80 + 80 + 1.0 kg ha^{-1} x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT).Whereas minimum seed index was (13.000 g) observed with F_1 = No fertilizer (Control)x W_1 = Weedy check (No weeding) respectively(Table 9).

Table 4. Seed Index (1000 kernel wt. g) of rice under the influence of nutrients levels and weed control practices

Nutrients levels	Weed control practices				Means
	Weedy check	Herbicide (2.5 L ha^{-1})	SWE (25 L ha^{-1})	Herbicide (1.25 L ha^{-1})+ SWE (25 L ha^{-1})	
F_1 = No fertilizer (Control)	13.000 I	20.367 DE	14.000 I	21.600 CD	**17.242 D**
F_2 = NPK160 + 80 + 80 kg ha^{-1}	12.933 I	24.133 B	15.380 H	24.600 AB	**18.878 C**
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}	18.733 FG	22.600 C	19.900 EF	25.833 A	**22.492 A**
F_4 = NPK+ B: 160 + 80 + 80 + 1.0 kg ha^{-1}	17.900 G	25.500 A	18.600 FG	24.867 AB	**21.375 B**
Mean	**15.642 D**	**23.150 B**	**16.970 C**	**24.225 A**	**-**

	Nutrients levels	Weed control practices	N×W
SE	0.3215	0.3215	0.6430
LSD = $_{0.05}$	0.6566	0.6566	1.3133

Kernel yield t ha^{-1}

Results showed that highest kernel yield t (9.2583 ha^{-1}) was obtained at F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} followed by (8.0583 ha^{-1}) was observed in F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} and the minimum kernel yield t (6.0333 ha^{-1}) at F_1 = No fertilizer (Control).In case of weed control practices the maximum kernel yield t (9.3167 ha^{-1}) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) followed by 8.0833 was recorded at W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT) whereas the lowest value (6.0000 ha^{-1}) was observed at W_1 = Weedy check (No weeding).The results further indicated that the interaction of nutrients levels and weed control practices showed highly significant response for kernel yield ha^{-1}. In interaction maximum kernel yield t (11.500 ha^{-1})was recorded with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT), followed by 9.3167 at F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT).Whereas, minimum kernel yield t (4.533 ha^{-1}) was observed with F_1 = No fertilizer (Control) x W_1 = Weedy check (No weeding) respectively (Table 11).

Table 5. Kernel yield t (ha^{-1}) of rice under the influence of nutrients levels and weed control practices

Nutrients levels	Weed control practices				Means
	Weedy check	Herbicide (2.5 L ha^{-1})	SWE (25 L ha^{-1})	Herbicide (1.25 L ha^{-1})+ SWE (25 L ha^{-1})	
F_1 = No fertilizer (Control)	4.533 I	6.533 G	5.500 H	7.567 EF	**6.0333 D**
F_2 = NPK: 160 + 80 + 80 kg ha^{-1}	5.467 H	7.667 E	6.600 G	8.633 C	**7.0917 C**
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}	7.500 F	8.600 CD	8.500 D	11.500 A	**9.2583 A**
F_4 = NPK+ B: 160 + 80 + 80 + 1.0 kg ha^{-1}	6.500 G	9.533 B	7.567 EF	9.567 B	**8.0583 B**
Mean	**6.0000 D**	**8.0833 B**	**7.0417 C**	**9.3167 A**	**-**

	Nutrients levels	Weed control practices	N × W
SE	0.0322	0.0322	0.0645
LSD = 0.05	0.0658	0.0658	0.1317

Protein content (%)

Based on results regarding the protein content (%) it is evident that maximum protein (10.900 %) was recorded at F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} followed by (10.608 %) was observed in F_4 = NPK+ B 160 + 80 + 80 + 1.0 kg ha^{-1} and the minimum protein (8.392 %) at F_1 = No fertilizer (Control) .In case of weed control practices the maximum ash (11.792%) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT) .followed by (11.142 %) was recorded at W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT) whereas the lowest value (7.950 %) was observed at W_1 = Weedy check (No weeding) .The results further indicated that the interaction of nutrients levels and weed control practices showed highly significant response for protein (%). In interaction maximum protein (13.000 %)was recorded with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT), followed by 12.700 at F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} x W_2 = Herbicide Machete 60 EC at 2.5 L ha^{-1} (10 DAT). Whereas, minimum protein(7.3671 %) was observed with F_1 = No fertilizer (Control) x W_1 = Weedy check (No weeding) respectively (Table12).

Table 6. Protein (%) of rice under the influence of nutrients levels and weed control practices

Nutrients levels	Weed control practices				Means
	Weedy check	**Herbicide (2.5 L ha^{-1})**	**SWE (25 L ha^{-1})**	**Herbicide (1.25 L ha^{-1})+ SWE (25 L ha^{-1})**	
F_1 = No fertilizer(Control)	7.367 I	8.400 G	7.933 H	9.867 E	**8.392 D**
F_2 = NPK: 160 + 80 + 80 kg ha^{-1}	7.533 HI	10.900 D	7.800 H	11.900 C	**9.533 C**
F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1}	8.500 G	12.567 B	9.400 F	13.000 A	**10.900 A**
F_4 = NPK+ B: 160 + 80 + 80 + 1.0 kg ha^{-1}	8.400 G	12.700 AB	9.067 F	12.400 B	**10.608 B**
Mean	**7.950 D**	**11.142 B**	**8.550 C**	**11.792 A**	**-**

	Nutrients levels	Weed control practices	N × W
SE	0.1027	0.1027	0.2054
LSD = 0.05	0.2097	0.2097	0.4195

DISCUSSION

In case of weed control practices the minimum values was recorded with W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT). However, minimum weed control at F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1} and lowest value (0.00 %) was observed at W_1 = Weedy check (No weeding). For direct cultivated rice, it is critical to keep field weed free for initial 30 days (Ramana et al., 2007). Similar results were also reported by Laxminarayan and Mishra (2001) that weeding and chemical treatments reduced weed population compared to weedy check. For nutrients levels, the maximum weed density was recorded at F_1 = No fertilizer (Control), maximum weed fresh biomass (g m^{-2}) was recorded at F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} and maximum weed dry biomass (g m^{-2}) was recorded at F_4 = NPK + B160 + 80 + 80 + 1.0 kg ha^{-1}. The weed control practices resulted maximum weed density 90.333 (m^{-2}) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT).

The effect of integrated nutrient and weed control practices on rice plant traits resulted for different nutrient levels as maximum panicle length cm, kernels $panicle^{-1}$ cm, seed index (1000 kernel wt. g), kernel yield kg (ha^{-1}) and protein (%) was recorded at F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1}. However, maximum crop growth rate (gm^{-2} day^{-1}) recorded at F_4 = NPK + B 160 + 80 + 80 + 1.0 kg ha^{-1}. In terms of integrated nutrient management practices similar findings are reported by Meena et al. (2016) and Redovnikovic et al. (2017) that a lack of these elements results in stunted root growth, ineffective seed generation, and lower yields. Thus, P and K are essential for nutrient absorption because they stimulate growth. The weed control practices resulted the maximum panicle length (cm), kernels $panicle^{-1}$, kernels wt. $panicle^{-1}$ (g), seed index (1000 yield wt. g), kernel yield kg (ha^{-1}), and protein (%) was recorded at W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT). However, maximum crop growth rate (gm^{-2} day^{-1}) was recorded at W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT). The results are in close agreement with Mukherjee and Singh (2005) who indicated that herbicides are viable against weed species, yet the greater part of them are explicit and are successful against slender scope of weed species.

However, interactive effect of integrated nutrient and weed control practices on rice plant traits resulted maximum interactive values for panicle length, kernels $panicle^{-1}$, seed index (1000 kernel wt. g), biological yield (t ha^{-1}), and protein (%) with F_3 = NPK + Zn: 160 + 80 + 80 + 6.0 kg ha^{-1} x W_4 = Herbicide Machete 60 EC at 1.25 L ha^{-1} + Sorghum water extract at 25 L ha^{-1} (10 DAT). The maximum kernels wt. $panicle^{-1}$ (g) was recorded with F_3 = NPK + Zn 160 + 80 + 80 + 6.0 kg ha^{-1} x W_3 = Sorghum water extract at 25 L ha^{-1} (10 DAT). Laxminarayan and Mishra (2015) further depicted that there is need to explore the efficacy of the method of controlling weeds with the application of fertilizers for augmenting the crop yield. Consequently, Plett et al. (2020) also advocated for incorporation of new phenotypic technologies, breeding strategies, and agronomic practices to improve crop yield production systems.

It is concluded that rice as major nutritional crop of world people needed well sensitization about adequate management of plant nutrients and controlled weeds (Plett et al., 2020). Consequently, nutrient management is critical in rice cultivation in order to achieve a stable grain yield and a good economic return while improving product quality (Paul et al., 2021). It encompassed a well understanding in terms of NPK levels, zinc, boron and weed management as well as suitable integration to support maximization of quality rice production is prerequisite. Therefore, adequate management of plant nutrients and weeds is crucial for the enhanced yield and quality of rice.

Conclusion

The study confirms to establish adequate management practices through different levels of nutrients and weed control for the enhancement of quality Paddy (rice) production. The integrated application of plant nutrients and weed control practices should be applied from sowing to harvesting for achieving higher yield of rice crop. The extended study of field and laboratory experiments should be conducted to determine efficacy of different NPK nutrient levels in terms of rice crop. Rice growers’ capacity should be raised while dealing with the rice plant nutrition to get higher yield by applying integrated approach with efficient weed control measures.

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