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Effects of Pre-Plants and Nitrogen Rates on Yield and Yield Component of Lowland Rice (*Oryza sativa* L.) Nutrition and Organic Matter of Soil

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Abstract: The dominant lowland rice-fallow system is being replaced with more intensive cropping systems and annual cropping systems without fallow in lowland rice. In order to investigate the effect of pre-plant and nitrogen rates on yield and yield component of lowland rice and nutrition variation and organic matter of soil. The study was carried out based on split plot in randomized complete block design with four replicates. The main plots were pre-plant sequences including (i) fallow-rice, (ii) maize-clover, (iii) maize-broad bean and (iv) maize-canola and the sub plots were nitrogen rates including 0, 23, 46 and 69 kg N ha^{-1}. Results indicated that pre-plant and nitrogen rates were significant in panicle length, number of effective tiller, number of panicle and number of total and filled spikelet per panicle at 0.05 and 0.01 probability levels, respectively. Nitrogen rates were significant in plant height, number unfilled spikelet per panicle and percentage of spikelet fertility at 0.01 probability. In all traits, maize-clover was maximum and maize-canola was minimum. Maize-clover had more grain yield (31%) than maize-canola. N_{69} had increased grain yield 30% related to fallow-rice. Maize-clover increased N, P, K and organic matter, but decreased by maize-canola relation to fallow-rice. High nitrogen increased biological yield and leaf area index and decreased harvest index relation to check. We conclude that grain yield responds to pre-plant. Maize-clover had greater grain yield (3985 Kg ha^{-1}) and fallow (3541 Kg ha^{-1}) than maize-canola (3037 Kg ha^{-1}). So, pre-plant increased nitrogen content of soil and could especially clover and broad bean substances with fallow or canola and decreased nitrogen fertilizer application.

Key words: Rice · Nitrogen · Grain yield · Pre-plant

INTRODUCTION

The dominant lowland rice-fallow system of farming is being slowly replaced with more intensive cropping systems and annual cropping systems canola-lowland rice without fallow. The production of rice was estimated at 2 million ton in Iran at 2008-2009, while consumption of it was 3.5 million ton. The balance of 1.5 million ton was obtained by importation [1]. Some of farmers in Iran, grow one single crop of lowland rice (lowland rice-fallow-lowland rice) in the main season and most farmers practice double cropping for example vegetables-lowland rice, corn-lowland rice, canola-lowland rice and clover-lowland rice. The lowland rice is planted in the main cropping season between May and June and is harvested in August and September depending on the maturity time of the rice variety. Farmers are allowed to drain until such a time when the land is no longer saturated and will support upland crop, such as vegetables, corn, canola and clover during the wet season. Considerable opportunity exists for growing the two crops between the main crops (lowland rice) in the dry season cropping [2,3,4]. The canola-lowland rice is one of the major agricultural production systems around 300 000 ha in the north of Iran. The intensive cultivated canola-lowland rice system is fundamental to employment, income and livelihoods for

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hundreds of farmers of north Iran.Grow canola before rice, delayed rice planting and caused yield losses and deficit water in grain filling period. In the last few decades, annual increases in growth rates for food grain and oil production have kept pace with population growth. Farmers in this region usually grow rice in the dry season (summer), followed by canola in the wet (winter) season. For rice, intensive wet tillage is practiced, whereas canola is grown as a dry land crop. The drastically different seedbed requirements for rice create problems in fertilizers, organic matter and crop residues [2,4].

However, crop rotations interact with management inputs [2]. Crop rotation has been shown to increase corn yield 5 to 30% and soybean yield from 8 to 16% compared to continuous production of either crop [3-9].

Crop rotation has also been shown to improve nitrogen use efficiency by reducing requirements for external input of fertilizer nitrogen. Compared to continuous corn, reduced fertilizer nitrogen inputs 17% for a corn-soybean rotation and reduced NO_3-N leaching loss through subsurface tile lines [10]. A study single-year of alfalfa or red clover was equivalent to corn yields obtained from applying 90 to 124 kg ha^{-1} of fertilizer nitrogen [11]. The evaluation period to 3 year of alfalfa managed as hay and reported that there was no significant corn grain yield response to fertilizer nitrogen [12].

High nitrogen inputs along flood irrigation (usually more than 100 mm per application) have resulted in severe nitrogen leaching ranging from 15 to 55% of applied nitrogen fertilizer and groundwater pollution (groundwater nitrate concentrations generally above 50 mg L^{-1}) [13, 14]. Interactions of nitrogen, irrigation and climate variations have substantial effects on crop yield, nitrogen and water use efficiency and nitrogen leaching [15-18]. Agricultural system models have been developed as tools to simulate crop and environmental responses to nitrogen and water management and to help extend the results of limited field experiments across different soils and climates [19, 20].

Nitrogen is the most expensive nutrient for growing grain crops [21]. Nitrogen fertilization can improve water use efficiency, but high nitrogen fertilization rates can result in excess biomass production, which uses up stored soil water needed for grain production [22]. Therefore, it is important to balance nitrogen fertilization with available seasonal water supplies and 67 kg N ha^{-1} applied to each crop was sufficient to optimize wheat and sorghum yields on a silt loam soil in Kansas [23]. Also, reported that no yield benefits to nitrogen applications above 84 kg N ha^{-1} on dry land winter wheat in wheat-corn-fallow and wheat-sorghum-fallow rotations on two loam soils in eastern Colorado [24].

The objectives of this study were to determine: (i) to provide the growth of rice and guide farmers can use crop rotation and they change their rotations by using short-duration rice, (ii) evaluate the influence of N fertilization rate and measure the effects of nitrogen rates and new pre-plants on rice yield and yield components and N, K, P and OM of soil residual.

MATERIALS AND METHODS

The experiment was conducted in 2009 cropping seasons at the farm of the Agriculture Research Center, Dashtenaz, Sari (36°42'N, 53°12' E), in Iran. The available long-term climatic data include rainfall and mean temperature and the average annual rainfall was 750 mm and average daily temperature was 28°C for period of 21 yr [25]. Climate data during the study had presented in Table 1. The soil level became flooded in May to September of each year. The top 1 to 30 cm soil layer had pH (1:2, soil/water) of 7.68, EC of 0.72 μmohs/cm, 17.4 mg kg^{-1} K measured using Flame photometry 35.50 g kg^{-1} organic matter (Walkley-Black method), 1.82 g kg^{-1} total N (Macro-Kjedahl method) and 16.09 mg kg^{-1} Bray extractable P. The textural class of the soil was silt clay (784 g kg^{-1} sand, 164 g kg^{-1} silt and 52 g kg^{-1} clay). Soil data during the study had presented in Table 2.

Table 1: Climatic data include mean of humidity, temperature, rainfall and evaporation of experimental farm at Sari in 2009

Variable		Evaporation (mm)	Humidity (%)	Temperature (°C)	Rainfall (mm)
Months	April	55.5	82	12.8	52.6
	May	93.7	77	17.7	16.6
	Jun	166.6	65	25.6	13.5
	Jul	136.3	76	25.5	31.7
	Aug	199.7	68	28	0.1

Table 2: Selected soil properties for composite samples at experimental site in 2009

Soil texture	K ppm	P ppm	N %	OC %	OM %	pH	EC μmohs/cm	Depth cm
Silt clay	35.50	16.09	0.18	1.82	3.18	7.68	0.91	0-30

The experiment was carried out in split plot as randomized complete block design with four replications. The main plots were pre-plant sequences including (i) fallow-rice, (ii) maize-clover, (iii) maize-broad bean and (iv) maize-canola. The sub plots were nitrogen rates including 0, 23, 46 and 69 Kg N ha^{-1}. Lowland rice variety namely Tarom-Mahali (early maturing) was planted in May in themain plot. The size ofmain plot was 80 m^2 (16 by 5 m) and the subplots size was 4 by 5 m.

Early maturing, lowland rice cultivar were planted in May and harvested in September in sequences. The seeds of lowland rice were sown on 10 May in 2009. The variety of lowland rice was sown with seedbed construction cropping cycle. Second crop (maize) was sown after rice harvest on 28 August in 2009. The agricultural calendar year, which began in May and ended in April of the following year constituted a cycle. Each sequence commenced in May with the planting of lowland rice as the first and the main crop. Crops were chosen because they were valuable crops grown with residual moisture without irrigation during the dry season to generate income. The lowland rice was transplanted on the 10 June in 2009. The lowland rice was harvested on 28 August in 2009. The lowland rice was spaced at 20 by 20 cm on a 5-m row plot giving a total stand population of 25 plant stands per square meter. The 1st and 20th row, were considered as the border rows while the 2nd, 3rd, 18th and 19th rows were considered as sample rows. The net plot was made up of the 6th to the 16th rows.

Basal fertilizer was applied at the rates 46 Kg P ha^{-1} and 100 Kg K ha^{-1} in the form of P-K (46-100) at 10 d before planting while nitrogen fertilizer was applied as basal and top dressing in the form of urea for all treatments at 1, 25 and 40 days after planting (DAP). The crops grown during the dry season were canola cv. Hayola 401, broad bean cv. Barkat and corn cv. KSC_{666}. These crops were established on the residual soil moisture at the spacing of 75 by 13 cm (10 plant m^{-2}) for corn and 40 by 16.5 cm (15 plant m^{-2}) for broad bean while canola 80 plant m^{-2} and clover was hand spread at 25 Kg ha^{-1}. The crops grown during the dry season in the first cycle were sown on 28 Aug. in 2009 whereas those of third cycles were sown 1 and 3 Nov. 2009. Three plant samples were taken from the sample rows of each plot for biomass at 50% heading and at maturity. All samples were oven-dried to constant weight at 70°C for 72 h. Other observations included the following: Plant height was measured at maturity with the aid of graduated ruler from ground level to the tip of the panicle. Grain yield of rice was determined from the 10 center rows that constituted the net plot (4 m^2, i.e., the 6th to 16th row of the plot). The brown panicles were harvested with the aid of a harvesting knife. The harvested panicles were sun dried, threshed, weighed and converted to Kg ha^{-1}.

Composite soil samples were taken from the entire experiment site after of the experiment for the determination of organic matter, N, P and K. samples were analyzed to determine the effects of pre-plant crops on organic matter, N, P and K between each cropping cycle. The soil chemical properties from the soil samples taken after lowland rice in each sub plot were subjected to analysis of variance by MSTAT-C program version 2.00 was used to run these analyses. Duncan Multiple Range Test (DMRT) was used to separate the treatment means.

RESULTS AND DISCUSSION

Yield Components: There was significant difference in plant height and panicle length among nitrogen rates at 0.01 probability level. Panicle length was significant difference in pre-plant at 0.05 probability level (Table 3). Increase plant height was observed as nitrogen rate increased. Plant height of N_0 and N_{69} with 130 and 146 cm were the lowest and longest, respectively (Table 4). This result is agreement with findings obtained by Ghanbari-Malidarreh (2009) [25], who observed increase plant height with increasing nitrogen fertilization level. Nitrogen increased plant height because there is competition among higher tillers number, leaf area and biological yield. As reported by [23], excess nitrogen can create a large plant and biomass production that uses up water needed for grain production. Panicle length of N_0 and N_{69} with 21.6 and 24.78 cm were the lowest and longest, respectively (Table 4). Panicle length of maize-clover had the highest with 25.05 cm and maize-canola the lowest with 21.82 cm (Table 4). The interaction of pre-plant × nitrogen rates on plant height and panicle length was significant difference at 0.05 probability level.

There was significant difference in number of effective tiller and number of panicle among pre-plant and nitrogen rates at 0.05 and 0.01 probability levels, respectively (Table 3). Number of effective tiller was decreased with maize-canola (16.56 tillers per hill) because decrease of soil nitrogen content result in decreasing the formation the smaller number of stalks of vegetative, vegetative bud and decrease vegetative phase. Pre-plant of maize-clover had the highest number of effective tiller with 22.18 tillers per hill (Table 4). Soil nitrogen content has effect on the vegetative stage and probably influence of vegetative organs. Thus, the number of panicle of

Table 3: Analysis of variance or some of rice traits in pre-plants and nitrogen rates at Sari in 2009

S.O.V.	df	Grain yield	Harvest index	Dry matter	Leaf area index	Plant height	Panicle length	Number of effective tiller	Number of panicle	Number of total spikelet per panicle	Number of filled spikelet per panicle	Number of unfilled spikelet per panicle	Percentage of fertility
Replication	3	196850.8 ns	133.2 ns	135787.8 ns	0.3 ns	83.4 ns	0.3 ns	78.1 ns	31222.9 ns	746.6 ns	36.7 ns	291.0 ns	315.8 ns
Pre-plants (A)	3	2266276.9 *	244.8 *	660608.2 **	5.3 *	42.6 ns	29.1 *	84.9 *	33956.3 *	1140.8 *	1376.6 *	42.6 ns	84.6 ns
Error (a)	9	335393.0	56.0	83893.9	1.2	156.3	6.2	21.2	8484.0	281.4	353.8	139.5	178.2
Nitrogen (B)	3	2300813.0 **	343.4 **	73862.0 **	4.7 **	597.0**	29.2 **	201.3 **	80572.9 **	741.3 **	1450.3 **	102.7 **	321.1 **
A×B	9	164274.4 ns	32.7 ns	34853.5 ns	0.7 ns	51.7*	1.2 *	8.4 ns	3367.4 ns	40.6 ns	30.0 ns	27.4 ns	38.2 ns
Error	36	158884.9	54.3	37998.2	0.6	23.7	0.5	9.6	3846.3	75.9	137.9	36.6	57.3
C.V. (%)	-	16.50	20.00	16.60	17.40	9.08	10.81	14.35	16.35	17.55	18.20	13.25	15.49

* Significant at P = 0.05, ** significant at P = 0.01, ns, non significant.

Table 4: Mean comparison of some of rice traits in pre-plants and nitrogen rates on rice at Sari in 2009

Treatments	Grain yield	Harvest index	Dry matter	Leaf area index	Plant height	Panicle length	Number of effective tiller	Number of panicle	Number of total spikelet	Number of filled spikelet	Number of unfilled spikelet	Percentage of fertility
Pre-plants	Kg ha^{-1}	%	g m^{-2}		Cm	cm	per hill	m^{-2}	per panicle	per panicle	per panicle	%
Fallow	3541.56 ab	35.97 b	1171.9 b	1.82 ab	138.58 a	23.13 b	19.75 ab	395.00 ab	96.51 ab	85.02 ab	11.49 a	86.74 a
Maize-Clover	3985.18 a	33.28 b	1430.56 a	2.42 a	139.03 a	25.05 a	22.18 a	443.75 a	104.42 a	94.10 a	10.32 a	88.83 a
Maize-Broad Bean	3437.40 bc	37.65 ab	1153.89 b	1.53 b	137.47 a	22.83 b	19.43 ab	388.75 ab	92.22 ab	79.44 ab	12.77 a	85.85 a
Maize-Canola	3037.83 c	42.58 a	934.01 b	1.03 b	135.37 a	21.82 b	16.56 b	331.25 b	86.21 b	72.10 b	14.10 a	83.27 a
Nitrogen rate Kg N ha^{-1}												
0	3037.97 c	43.54 a	910.48 c	1.09 c	130.15 c	21.61 d	15.12 c	302.50 c	87.38 c	71.98 c	15.40 a	80.25 b
23	3361.61 b	37.81 b	1100.11 b	1.58 bc	136.81 b	22.74 c	18.12 b	362.50 b	91.26 bc	78.55 bc	12.71 ab	85.29 ab
46	3647.95 b	35.49 bc	1274.52 a	1.72 b	138.46 b	23.70 b	21.81 a	436.25 a	97.26 ab	86.12 ab	11.41 b	88.78 a
69	3954.48 a	32.12 c	1405.3 a	2.41 a	145.02 a	24.78 a	22.87 a	457.50 a	103.40 a	94.02 a	9.43 b	90.37 a

Values within a column followed by same letter are not significantly different at $P = 0.05$.

maize-clover had the highest with 443.75 panicle/m^2 and maize-canola had the lowest with 331.25 panicle/m^2 (Table 4). Increases in the number of tiller as a response to nitrogen fertilization were related to the cultivar stimulation to produce tillers, which is related to the greater nitrogen availability to plants. The number of effective tiller of N_0 and N_{69} with 15.12 and 22.87 tillers were the lowest and highest, respectively (Table 4). Increase number of tiller, provided by the increasing nitrogen rates, contributed to increase leaf area index, also reduction in fertile tiller could be related to the greatest number of stalks produced as nitrogen fertilization increased. High nitrogen rates induce the formation of large number of stalks and leaves, creating favorable conditions to yielding. The number of panicle of N_{69} had the highest with 457.50 panicles and N_0 had the lowest with 302.50 panicles (Table 4). Higher amount of nitrogen available for the plant could increase tillering duration and number of panicle. The number of panicles is defined during the period from ten days after transplanting to 15 days before the booting stage is visible. Since, it occurs as a direct function of the number of stalks depending to genetic and environmental factors. Nitrogen rates increased number of tillers and occurred with number of panicle.

There was significant difference in the number of total spikelet and number of filled spikelet among pre-plant and nitrogen rates at 0.05 and 0.01 probability levels, respectively (Table 3). Number of total spikelet and number of filled spikelet in pre-plant maize-clover was the highest with 104.42 and 94.10 spikelets and pre-plant maize-canola was the lowest with 86.21 and 72.10 spikelets, respectively. So, fallow-rice had similar to pre-plant maize-broad bean. However, the number of tiller and biological yield is the most important in spikelet formation and probably there is a correlation between two traits. Therefore, nitrogen had influence number of total spikelets and number of filled spikelets. N_{69} and N_0 had the highest and lowest spikelets with 103.40 and 94.02 spikelets, respectively. When levels of nitrogen had increased an increase was obtained in the number of total spikelets and number of filled spikelet.

The number of unfilled spikelet and percentage of spikelet fertility also differed for nitrogen rates and was significant difference at 0.01 probability level (Table 3). The highest number of unfilled spikelet was recorded for N_0 with 15.10 spikelets and the lowest was recorded for N_{69} with 9.43 spikelets (Table 4). Results for spikelet fertility were inversion. Spikelet fertility expresses the percentage of spikelet that turned into grain.

However, N_0 had the highest number of unfilled spikelet and decrease with increasing nitrogen fertilization (Table 4). Reduction observed was probably caused by limiting source and relation between sink and source for yielding higher production of photo assimilates. Therefore, reducing the area of active photosynthesis, reducing the production of assimilates, that otherwise would be directed to grain filling and increasing the number of unfilled spikelet, consequently reducing spikelet fertility. That caused plants to have enough carbohydrates to fill up all spikelets produced as the nitrogen fertilization level increased, contributing to increase the number of unfilled spikelets and to decrease fertility, lowering productivity.

Leaf Area Index: There was significant difference in leaf area index among pre-plants and nitrogen rates in 0.05 and 0.01 probability levels, respectively. Leaf area index of maize-clover was highest with 2.42, but maize-canola was the lowest with 1.03. Leaf area index of N_0 and N_{69} with 1.09 and 2.41 were the lowest and highest, respectively. These results confirm by data table 8 that soil nitrogen content was high. Leaf area index produced greater biological yield and higher number of effective tiller, so rice plant used from fertilizer and environment for grain yield.

Yield: There were significant difference in grain yield among pre-plant and nitrogen rates in 0.05 and 0.01 probability levels, respectively. Grain yield pre-plant of maize-clover was highest with 3985 Kg/ha, but maize-canola was the lowest with 3037 Kg/ha. Small residual benefits of green manure to the following crop have been reported in rice-rice (Becker *et al*., 1994) [26] and rice-wheat (Aulakh *et al*., 2000) [27]. Hence, canola decreased production biological yield and leaf area, because canola needs too much nitrogen for growth that absorbed nitrogen from soil. Grain yield of N_0 and N_{69} with 3037 and 3954 Kg/ha were the lowest and highest, respectively. It can be concluded that if the amount of nitrogen had increased we will have an increase in the grain yield, because we have an increase in the dry matter. Grain yield were significantly different for pre-plant. So, grain yield (3037 Kg/ha) in maize-canola was the lowest (Table 4). Pre-plant difference was significant when comparing to fallow-rice with the other treatments. Grain yield for rice sown after fallow as fallow-rice was similar to pre-plant using maize-broad bean. Incorporating rice residue had no effect on wheat yields in the presence of urea N, but rice residue depressed wheat yields without urea N (Aulakh er al., 2001) [28]. This change is attributed to nitrogen absorption by corn substance by Broad Bean that similar with fallow-rice. Unfortunately, the pre-plants used in this study is common available. Indicated that the lowest rough rice yield was in fallow-rice and grain yields were highest in the rice-soybean and rice-corn [29]. Consistently, equal or higher grain yields from the standard fertility treatment compared to the enhanced fertility treatment support current recommendations and suggest that higher N, P and K rates may not result in increased grain yields. This result was agrees with report of, showed that increasing phosphorus and potassium levels resulted in increased soil P and K levels but were not associated with increased grain yields [29]. Results were agreed with reports by Byerlee, 1992 [26], who long-term experiments on annual rice-wheat double-crop systems in China indicate that productivity of rice and wheat has been declining. Therefore, inadequate or imbalanced nutrient management and decreasing soil organic matter are probably the factors in the declining trend in this cropping system [30].

There was significant difference in harvest index and biological yield among pre-plants and nitrogen rates in 0.05 and 0.01 probability levels, respectively (Table 3). The comparisons of pre-plants (Table 4) indicate the highest and lowest value of harvest index find in Maize-Clover (33.3 %) and Maize-Canola (42.5%). Maize-canola and maize-clover had lowest and highest biological yield with 934 and 1430 $g.m^{-2}$, respectively. Nitrogen fertilization can improve water use efficiency, but high N fertilization rates can result in excess biomass production, which uses up stored soil water needed for grain production [22]. These results were similar to leaf area index for treatments. These results agrees with results of [22], who a positive response to the application of this element. However, in opposition to results Aulakh *et al.* (2001) [28] not observe any influence of nitrogen on this yield component. Total biomass production was not significantly affected by pre-plant for the wheat-corn-fallow and wheat-sorghum-fallow [28].

Soil Nutrient: There was significant difference in nitrogen, phosphate, potassium and organic matter among pre-plants in 0.01 probability levels (Table 5). Results indicate that soil nitrogen concentration had decreased in soil nitrogen concentration in fallow-rice regardless of nitrogen rates treatment (Table 6).

Table 5: Analysis of varianceon some of soil traits pre-plant system on rice at Sari in 2009

S.O.V.	df	Organic matter	Nitrogen	Phosphor	Potassium
Replication	3	0.024 ns	0.000068 ns	1.104 ns	1341.667 ns
Pre-plants	3	0.473 **	0.00303 **	195.576 **	8908.333 **
Error	9	0.008	0.000083	6.676	1091.667
C.V. (%)	-	3.43	6.36	9.15	5.70

* Significant at P = 0.05, ** significant at P = 0.01, ns, non significant.

Table 6: Mean comparison on some of soil traits in pre-plant system on rice at Sari in 2009

Treatments	Organic matter	Nitrogen	Phosphate	Potassium
Pre-plants	%	%	ppM	ppM
Fallow	2.587 a	0.142 b	37.90 a	640.00 a
Maize-Clover	2.887 a	0.185 a	27.95 b	577.50 b
Maize-Broad Bean	2.582 b	0.140 b	25.50 c	572.50 b
Maize-Canola	2.060 c	0.107 c	21.50 bc	525.00 b

Values within a column followed by same letter are not significantly different at $P = 0.05$.

In fallow-rice, there was a reduction in soil nitrogen concentration in the no-nitrogen plots when compared to nitrogen application plots. Soil organic matter showed the same trend as soil nitrogen concentration where soil nitrogen concentration was higher in the maize-clover when compared to fallow-rice (Table 6). The benefits of sequestering soil organic carbon to sustaining crop productivity by applying organic amendments and crop residue and including legumes in pre-plants have been well documented in the temperate regions [28]. Also, these results suggest a possible benefit from maize-clover through additional nitrogen being supplied in the pre-plant system; a result that could lead to decreased nitrogen fertilizer use.

That fertilizer nitrogen uptake at the higher nitrogen rate was lower in fallow-rice when compared to the rice-soybean. Lower nitrogen uptake in fallow-rice may have contributed to reduced grain yields in that pre-plant [29].

The soil phosphate concentration showed a trend of increased decline in the soil phosphate concentration in the maize-clover compared to fallow-rice. The soil potassium concentration showed the same trend as soil phosphate concentration where potassium concentration was higher in fallow-rice when compared to the maize-clover (Table 6). So, increasing phosphorus and potassium levels resulted in increased soil phosphate and potassium levels but was not associated with increased grain yields [29]. The results indicated soil nitrogen, phosphate, potassium concentrations and organic matter was higher than fallow-rice system in comparison to maize-canola. Soil nitrogen, phosphate potassium concentrations was higher in the maize-clover when compared to the maize-broad bean and there were differences between pre-plant treatments (Table 6). Therefore, this increase has resulted in increased grain yield. Increase soil nitrogen concentration resulted in higher grain yield. Researchers believe decreased soil nitrogen, phosphate, potassium concentrations in fallow-rice when compared to the maize-broad bean and maize-clover contributes to lower grain yields and that increases in soil nitrogen, phosphate, potassium concentrations in the pre-plants impact yields because that uptake occurs later in the growing season. That soil nutrient data collected in four tears showed a trend of increasing phosphate and potassium levels in the enhanced fertility plots when compared to standard fertility plots [29].

CONCLUSION

In general, in the flooding rice cultivation due to the physical erosion of soil organic matter in cultivated soil flooding reduced. There are a flooding irrigation system duo to leaching high nutrients particularly nitrogen that result increased use of nitrogen fertilizer. So it can be used pre-planting appropriate plants to improve soil physical properties of soil organic matter and increase soil nitrogen and improve storage. According to the survey results pre-planting corn-clover has been the best in rotation with rice crops and increase soil organic matter and nitrogen; also the increase grain yield of rice and nitrogen fertilizer can be reduced as well. But in the absence of excess nitrogen to the soil with rice cultivation and yield can be reduced through the lodgings and the disease it seems to be that canola cultivation before rice emptying soil nitrogen and it is usable.

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