EFFECT OF SEEDING DENSITY, PHOSPHORUS LEVELS ON THE YIELD AND NUTRITIONAL QUALITY OF RYEGRASS (*LOLIUM MULTIFLORUM* L.) IN PUNJAB, PAKISTAN.

M. Rashid[*], F. Ahmad[**], A. Yaseen[***], Z. Habib[***] and M. Rizwan[***]

[*]Research Officer Fodder Crops, Livestock Production Research Institute Bahadurnagar (Okara).
[**]Superintendent, Livestock Experiment Station Qadarabad (Sahiwal).
[***]Research Officers Livestock Production Research Institute & Instructor Livestock services Training Center Bahadurnagar (Okara).
Corresponding Author email: mruaf@yahoo.com

ABSTRACT: A field experiment was conducted at Livestock Production Research Institute Bahadurnagar (Okara), Punjab, Pakistan during the Rabi season 2024-2025. Soil samples were collected at 30 cm depth before sowing the crop for its physical and chemical analysis. The crop was sown during the month of October, 2024. The experiment was laid out in RCBD design with three replications. The treatments consisted of three different seed rates 15,20 & 25kgha^{-1} along with three levels of Phosphorus fertilizer rates 0, 100,150 and 200 P_2O_5 kgha^{-1} and with all their possible combinations. The crop was harvested at panicle initiation stage to record the yield data. It was found that green fodder yield of 64 tons ha^{-1}, fresh weight of green fodder per plot 191 kg per plot and 17 number of tillers per plant respectively were obtained at treatment where seed and phosphorus (P_2O_5) were applied @ 25 kgha^{-1} & 200 kg P_2O_5 ha^{-1} which were at par with seed rate of 25 kg ha^{-1} and phosphorus 150 kg P_2O_5 ha^{-1}. Maximum plant height 116 cm was obtained at treatment where seed and phosphorus (P_2O_5) were applied 25 kg ha^{-1} & 200 kg P_2O_5 ha^{-1}. There was no difference in number of leaves per plant with the change of treatments. Plant samples were collected for quality parameters. It was found that Crude Protein, Crude Fiber, Ash, Dry Matter, moisture content & ether extract in samples were 9, 19.97, 12.06, 25.15, 74.85 & 1.63 % respectively while Dry Matter yield 16.04 Ton ha^{-1} were obtained where seed & Phosphorus used were 25 kg ha^{-1} and 200 kg P_2O_5 ha^{-1}. The soil samples were collected after harvesting the crop from the plot of each treatment and it was found that the available soil Phosphorus level increased with the increasing rate of its application, maximum available Phosphorus was 13.90 ppm where Phosphorus (P_2O_5) was applied 200 kg P_2O_5 ha^{-1}. The data was analyzed statistically by using Proc. GLM procedure of SAS version 9.4 (SAS. 2017) and significant mean differences were tested by using Fisher's protected least significant difference (LSD) test at $\alpha = 0.05$.

Key words: - Seed & Phosphorus fertilizer rates, Fodder yield, Plant height, Fodder quality & Soil Fertility Status.

(Received 15.04.2025 Accepted 01.06.2025)

INTRODUCTION

Livestock population is primarily dependent on crop residues. Feeding the animals with quality fodder is a major challenge for farmers. The shortage of feed and fodder resources indicates that most of the livestock species are under fed. Such shortage on feed and fodder resources combined with growing livestock population and less emphasis on forage cultivation by the livestock owners resulted in low productivity of animals. Proper crop planning is a pre-requisite for uninterrupted supply of nutritious green fodder for maintaining the higher productivity of dairy animals. Moreover, winter months are considered as the lean period for the fodder supply. So, growing winter forage is very important to cope with fodder shortage during the lean period.

Rye grass (Lolium spp.) is a cool season forage to feed the ruminant animals. It is fast germinating, quick growing and requires low to medium fertilization. In Punjab, Pakistan, presently the Berseem & Lucerne are the leguminous fodder crops with green fodder production from four to five numbers of cuts and oats is the cereal fodder crop with green fodder production from one or two cuts. In view of the above, Rye grass is a suitable option as Rabi season fodder crops which has numbers of merits over Berseem, Lucerne & oats in respect of yield, productivity and quality.

Among crop management practices seeding densities/plant population greatly influences the crop growth which ultimately affects the green fodder yield. Hence seed rate is an important factor to assess the green fodder yielding capacity of any cultivar. Both over and

substandard plant population is the major cause of low yield (*Jan et al*., 2000). Optimum seed rate plays an important role in contributing to the high yield because in case of thick plant population, most plants remain sterile, easily attacked by diseases as compared to normal population.

There is a good correlation between seed rate, plant population and increasing levels of nitrogen in relation to fodder yield (*Sarat et al*, 2019). In view of these facts there is need to see the effect or response on two important component technologies viz. suitable seed rate and Phosphorus levels as this is a new forage crop for Punjab. The present study was undertaken to find out the proper seed rate in combination with suitable level of Phosphorus to see the growth as well as green forage yield of Rye grass.

MATERIAL AND METHODS

A field experiment was conducted during Rabi season of 2024-25 in the field area of Livestock Production Research Institute Bahadurnagar (Okara). The latitude of Okara, Punjab, Pakistan was 30.808500, and the longitude was 73.459396. Okara, Punjab, Pakistan was located at Pakistan country in the Cities place category with the GPS coordinates of 30° 48' 30.6000" N and 73° 27' 33.8256" E. The coldest months were from December to February, when temperatures may drop to 3 °C (37 °F), with moderate rainfall. The hottest months were May to July, when temperatures may reach 45 °C (113 °F). The annual average rainfall in the city was approximately 509 mm (20.0 inch) *(www.google/ com/search/ geographical/ okara/ Pakistan.)*

Composite soil samples (five random core samples from each plot, thoroughly mixed together) were collected from the surface layer (0–30 cm) from the field before sowing the crop for its physical and chemical soil properties i.e., Texture, Organic Matter, Phosphorus, Potassium, $CaCO_3$, EC, pH, and CEC determination (U.S. Salinity Lab. Staff. 1954). The data on physical and chemical soil properties analyzed was as given in table-1

Table 1: Physical and Chemical Soil Properties.

Property	Soil sampling Depth 0-30 cm
EC (d Sm^{-1})	1.9
pH	8.8
$CaCO_3$ (%)	7.6
O.M (%)	0.87
Available P (ppm)	6.00
Available K (ppm)	180
Sand (%)	40
Silt (%)	35
Clay (%)	25
Textural Class	Loam

The field experiment was laid out in RCBD design. The crop was sown during the month of October 2024. The treatments consisted of three different seed rates i.e. 15, 20 & 25 kg ha^{-1} along with four levels of Phosphorus i.e.0,100, 150 and 200 P_2O_5 kg ha^{-1} in the form of DAP and with all their possible combinations which were as follows.

Table 2: Detail of treatments and its possible combinations.

Treatment #	Treatments	Seed rate	P_2O_5
		Kg ha^{-1}	
T_1	S_{15} X P_0	15	0
T_2	S_{15} X P_{100}	15	100
T_3	S_{15} X P_{150}	15	150
T_4	S_{15} X P_{200}	15	200
T_5	S_{20} X P_0	20	0
T_6	S_{20} X P_{100}	20	100
T_7	S_{20} X P_{150}	20	150
T_8	S_{20} X P_{200}	20	200
T_9	S_{25} X P_0	25	0
T_{10}	S_{25} X P_{100}	25	100
T_{11}	S_{25} X P_{150}	25	150
T_{12}	S_{25} X P_{200}	25	200

Variety Ryegrass-1 was used which is a promising rye grass variety developed by the Fodder Research Institute Sargodha. Each treatment was replicated three times. The size of the plots was 6.0 X 10.0 m. Before sowing, the land was prepared well with the help of tractor drawn cultivator and disc harrow followed by planking to make the seed bed smooth and firm.

Ryegrass variety R-1was sown in October 2024 by broad casting the seed as per treatment. Phosphorus fertilizer, i.e.0, 100, 150 and 200 P_2O_5 kg/ha in the form of DAP, was applied before sowing the crop. Nitrogen was applied at the rate of 250 kg/ha in the form of Urea in two equal split doses i.e., half of N was applied during final ploughing, 1/2 at plant height of 12 inches. Post sowing irrigations were given to the crop as per need of the crop. The crop was harvested manually with sickle at panicle initiation stage of growth to record the yield data i.e. green fodder yield (kg/ha), number of tillers per plant and length of plant (cm). Green fodder yield was recorded by harvesting the whole plot. Plant height was measured from ground level to the base. The number of tillers per plant were recorded. The crop from each net plot (leaving border rows) was harvested and immediately weighed in kg/plot and then converted into Ton/ha. Plant samples were collected for quality

parameters i.e. CP%, CF%, Ash%, DM%, moisture contents% and ether extract (%). The soil samples were collected after harvesting the crop. The data was analyzed statistically by using Proc. GLM procedure of SAS version 9.4 (*SAS. 2017*) and significant mean differences will be tested using Fisher's protected least significant difference (LSD) test at $\alpha = 0.05$.

RESULT AND DISCUSSION

It was revealed from the data recorded that treatment T_{12} (Seed 25 kg ha^{-1} & P_2O_5 200 $Kgha^{-1}$) gave maximum plant height (116) cm, number of tellers per plant (17), Number of leaves per plant (5), green fodder yield (64 tons ha^{-1}.),dry matter yield (16.04 tons ha^{-1}.), Moisture % (74.85), Ash% (12.06), Crude Fiber % (19.97), Crude Protein (9%) which is more than all other treatments in the experiment and Ether Extract (1.63%) which was less. The available phosphorus (ppm) level increased in the soil with the increasing level of phosphorus application rates.

The data regarding the germination of seeds showed that there was no effect of treatment on the germination percentage of seed (Table: -3). These findings are contradictory to the findings of Bray *et al*., (1989) and Arif *et al*, (2005) who reported that seed priming enhanced germination which may be attributed to repair processes, a buildup of germination metabolites or osmotic adjustments during priming treatment. Germination Count (m^{-2}). Aroosa Kanwal *et al*., 2022, reported that the germination count of forage oat was significantly affected by different seed rates, while the main effects of the N level were nonsignificant. Similarly, the interactive effect of the seed rate and N level was also nonsignificant. The highest germination count was recorded for S_3 (138.77 m^{-2}), whereas the lowest plant population (108.42 m^{-2}) was noted for S_1. The higher germination count is directly linked to a higher seed rate used.

The data given in table: -3 regarding plant height (cm) revealed that maximum Plant height obtained was 116 cm at T_{12} (seed rate 25 Kg $ha^{-1}$and 200 kg P_2O_5 $Kgha^{-1}$) compared with treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest plant height 62 cm. The results are in conformity with Sarma *et al*, 2020 & Sidhu *et al*, 2020. Satpal *et al.*, (2022), reported that with increasing level of Phosphorus from 30,40 & 50 P_2O_5 Kg ha^{-1}, the plant height increased from 47.384 to 53.60 cm. The findings of Hongli Huang *et al*.,(2024) revealed that an optimal application of suitable phosphate fertilizers elevated the soil's pH and electrical conductivity (EC), facilitated the conversion of soil from insoluble phosphorus into available forms, augmented the release of pertinent enzyme activity, and induced the expression of phosphorus cycling-related genes. These enhancements in soil conditions significantly promoted the growth of ryegrass. When applying phosphorus at a rate of 600 mg/kg, ryegrass exhibited plant height, dry weight, and chlorophyll relative content that were 1.27, 1.26, and 1.18 times higher than those in the control group (P_0).

Green fodder yield (Tons ha^{-1}) of Ryegrass affected by different seed rates and levels of Phosphorus showed that maximum green fodder yield obtained was 64 tons ha^{-1} at T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}) compared with treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest green fodder yield 40 tons ha^{-1} (Table: -3). Satpal *et al*, 2022, reported that among different phosphorus levels, highest Green Fodder Yield was recorded at P_3 (50 kg $P_2O_5ha^{-1}$) which was on a par with P_2 (40 kg $P_2O_5ha^{-1}$). The green fodder and dry matter yield recorded with 50 kg $P_2O_5ha^{-1}$ were 3.78, 22.79 and 4.72, 35.51 per cent higher over 40 and 30 kg $P_2O_5ha^{-1}$ respectively.

Fresh weight (kg $plot^{-1}$) of Ryegrass affected by different seed rates and levels of Phosphorus showed that maximum green fodder yield obtained was 191 kg $plot^{-1}$ at T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}) compared with treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest green fodder yield 121 kg $plot^{-1}$ (Table: -3). The results are in conformity with the findings of Satpal *et al*, 2022.

The data regarding the number of leaves per plant showed that there was no effect of treatment on the number of leaves per plant (Table: -3).Tillers/plant of Ryegrass affected by different seed rates and levels of Phosphorus showed that maximum number of tillers per plant obtained were 17 tillers $plant^{-1}$ at T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}) which were at par with treatment (T_{11}). Minimum number of tillers per plant were 14 at treatment (T_1) which were at par with number of tillers obtained at T_2 to T_4. The increasing rate of seed and Phosphorus levels positively affect the number of tillers per plant. (Table: -3). Satpal *et al*, 2022, reported that the number of tillers per plant increased with increasing level of Phosphorus application from 30,40 & 50 P_2O_5 Kg ha^{-1}. Gezahegne Kebede *et al*., 2024 stated that Pearson correlation analysis indicates that the number of tillers per plant, yields of morphological fractions (leaf, stem, and panicle), forage yield production rate, nutrient concentration, and uptake had significant positive associations with fertilizer levels and fodder yield.

The data regarding dry matter yield (Tons ha^{-1}) table: -4 revealed that Ryegrass produced maximum dry matter yield 16.04 Tons ha^{-1} at T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}) compared with treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest dry matter yield 08.06 Tons ha^{-1}. The results are in conformity with the findings of Satpal *et al*, 2022, who reported that the dry matter increased (Tons ha^{-1}) with increasing level of Phosphorus application from 30,40 &

50 P_2O_5 Kg ha^{-1}. Munir A. TURK *et al.,* 2003, stated that the seeding rate, seeding date and rate of phosphorus had a significant effect on most of the measured traits and the yield components. In general, a high seeding rate (80-plant·m^{-2}) and P application (52.5 kg· P· ha^{-1}) drilled with the seed after cultivation (banded) are promising for obtaining maximum yield of Varbon vetch.

The data regarding moisture contents (%) table: -4 showed that maximum moisture contents were found in Ryegrass at T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest dry matter yield 08.06 t/ha while highest moisture contents in ryegrass were found at T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}).The results are in conformity with the findings of Ankit *et al*, 2023, who reported that with increasing levels of seed rate higher the dry matter and green fodder yield owing to significant increase of growth attributes over lower levels of seed rate.

The data regarding dry matter contents (%) table: -4 revealed that Ryegrass produced maximum dry matter contents 25.15% at T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}) compared with treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest dry matter contents 19.97%. The results are in conformity with the findings of Satpal *et al*, 2022 that total dry matter yield (q ha^{-1}) increased with increasing level of Phosphorus application rates.

The data regarding crude protein (%) table: -4 revealed that crude protein 9 % was found in ryegrass at treatment T_{12} (seed rate 25 Kg $ha^{-1}$and P_2O_5 Kg ha^{-1}) which was at par with T_7 to T_{10} and was highest compared with treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest crude protein 7% which was at par with T_2 to T_3. The crude protein increased in Ryegrass with increasing level of Phosphorus application rate. The results are in conformity with the findings of Satpal *et al*, 2022 that the crude protein yield (q ha^{-1}) and crude protein contents (%) increased with increasing levels of Phosphorus application rates.

The data regarding crude Fiber (%) table: -4 revealed that crude Fiber 19.97 % was found in ryegrass at treatment T_{12} (seed rate 25 Kg $ha^{-1}$and 200 Kg P_2O_5 ha^{-1}) which was highest compared to treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest crude fiber 12.33%. The crude fiber increased in Ryegrass with increasing level of Phosphorus application rates. Aroosa Kanwal. *et al*, 2022, reported that variation in seed rate and N level significantly affected the crude fiber percentage. The highest crude fiber percentage was observed for S_3N_5, while S_2 N_1 resulted in the lowest crude fiber percentage. Google research gate crude fiber % in ryegrass as affected by seeding density and Phosphorus levels. In perennial ryegrass, crude fiber content is influenced by both seeding density and phosphorus application rates. Higher seeding densities generally lead to increased forage yield, potentially impacting crude fiber concentration. Similarly, phosphorus fertilization can affect crude fiber content, especially in relation to the plant's ability to utilize nitrogen.

Seeding density and phosphorus (P) application rates can influence the ash percentage in ryegrass. While ash content is generally not directly related to P application, higher P availability, especially in P-deficient soils, can contribute to overall plant health and potentially impact biomass and ash composition indirectly. Seeding density affects plant competition and resource allocation, which can also influence ash content. The data regarding Ash /Mineral contents (%) table: -4 revealed that Ash /Mineral contents 12.06 % was found in ryegrass at treatment T_{12} (seed rate 25 Kg $ha^{-1}$and 200 Kg P_2O_5 ha^{-1}) which was highest compared to treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) with lowest Ash/Mineral contents 8.42%. Ash/Mineral contents increased in Ryegrass with increasing level of Phosphorus application rates.

In perennial ryegrass, ether extract percentage (a measure of lipids) can be influenced by both seeding density and phosphorus application rates, though the exact nature of these effects may vary. Higher seeding densities, while potentially increasing overall forage yield, may not necessarily lead to changes in ether extract percentage, as seen in some studies with perennial ryegrass and white clover mixtures. Phosphorus application, however, can significantly impact the chemical composition, including ether extract, and the timing of this impact can vary depending on the stage of plant development. The data regarding Ether Extract (%) table: -4 revealed that Ether Extract 2.50 % was found in ryegrass at treatment T_1 control (seed rate 15 Kg ha^{-1}& no Phosphorus fertilizer) which was highest compared to treatment T_{12} (seed rate 25 Kg $ha^{-1}$and 200 Kg P_2O_5 ha^{-1}) with low Ether Extract 1.63%.The Ether Extract decreased in Ryegrass with increasing level of Phosphorus application rates.

Soil Fertility Status after harvesting the crop:-The data given in table-5 showed that Phosphorus application rate decreases soil electrical conductivity (EC) dSm^{-1}. The increase in EC (dSm^{-1}) is often linked to the addition of water-soluble salts. However, the effect can vary depending on the soil type, the amount of phosphorus applied and the presence of other nutrients or soil conditions. The result regarding EC (dSm^{-1}) given in table-3 showed that maximum EC 1.37 dSm^{-1} was found where Phosphorus was applied at 200 Kg P_2O_5 ha^{-1} and was 1.31 dSm^{-1} lowest where no Phosphorus was applied. The results are in conformity with the findings of Tarun Kumar *et al*; (2019) who reported that the maximum Electrical Conductivity was 0.22 dSm^{-1}) of soil was found in treatment where 120 Kg N ha^{-1} and 60 Kg P ha^{-1}

were applied while the minimum value was 0.16 dSm^{-1} at control. The mean value of EC (dSm^{-1}) of soil was found non-significant at different levels of N and P. It was also observed that the EC of soil gradually increased with an increasing dose of N and P. The data regarding the saturation % given in table-3 depicts that the maximum saturation % of soil was 32% and increased with increasing level Phosphorus. This is due to the reasons that roots proliferate with the application of Phosphorus and increase the surface area hence increase the saturation %. The results are in line with the findings of Tarun Kumar *et al*; (2019). They found that water holding capacity (%) was maximum in treatment where 120 Kg N ha^{-1} and 60 Kg P ha^{-1} which was 39.29 % while the minimum values of the result were found in control which was 29.57 % respectively. Water holding capacity of soil was found significantly different. The effect of N and P on water holding capacity of soil was also found significant.

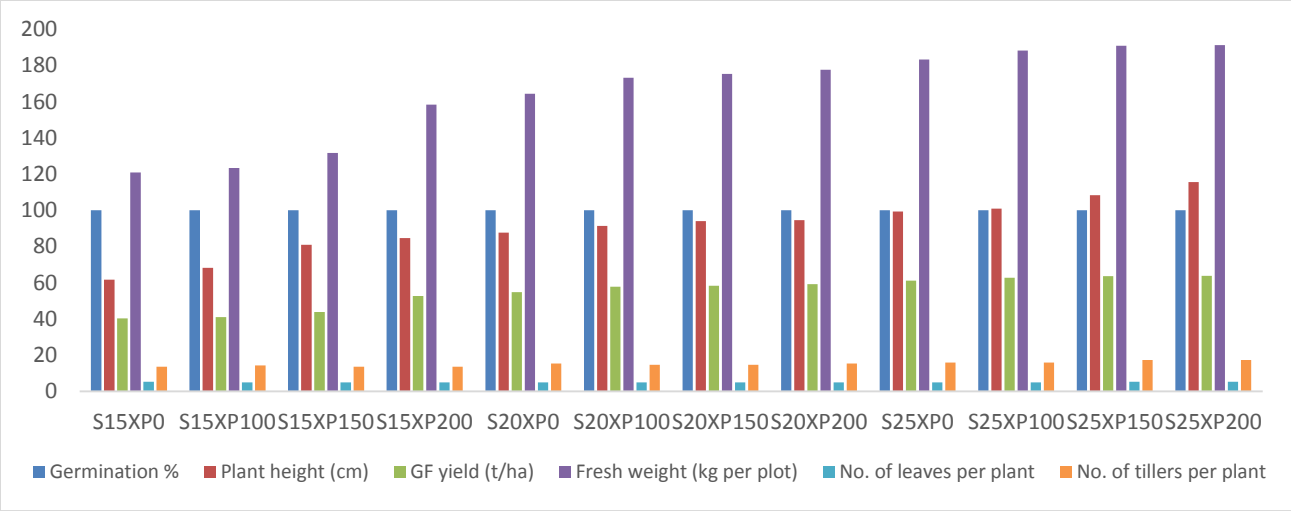
The result of data given in table-5 regarding pH value showed that the maximum pH value of soil was found where Phosphorus was applied 200 Kg P ha^{-1} while minimum value of pH found was 9.3 at control and was at par where Phosphorus was applied 100 Kg P ha^{-1}. The results are in conformity with the findings that the effect of P on soil pH is complex and depends on various factors. Some studies indicate that P addition might lead to a slight increase in soil pH, particularly in acidic soils. This could be due to the buffering effect of P-containing compounds or the release of alkaline elements during the reaction with soil minerals. Phosphorus addition to soil can have various effects on soil pH, depending on the initial soil pH and the form of phosphorus applied. In some cases, phosphorus application may slightly increase soil pH, while in other cases, it may have no significant impact. https://www.google.com/search?q =Effect + of+ Phosphorus +rates +on+ soil+pH. Yun Xia *et al*;2024, reported that P addition improved soil conditions for microbial growth by increasing soil pH and P availability.

Table 3: Effect of seeding density, Phosphorus level on germination%, Plant height (cm), Green Fodder yield (t/ha), Fresh weight (kg per plot), No. of leaves per plant & No. of tillers per plant.

Treatment	Germination %	Plant height (cm)	GF yield (t/ha)	Fresh weight (kg per plot)	No. of leaves per plant	No. of tillers per plant
$S_{15}XP_0$	100	62	40	121	5	14
$S_{15}XP_{100}$	100	68	41	123	5	14
$S_{15}XP_{150}$	100	81	44	132	5	14
$S_{15}XP_{200}$	100	85	53	158	5	14
$S_{20}XP_0$	100	88	55	164	5	15
$S_{20}XP_{100}$	100	91	58	173	5	15
$S_{20}XP_{150}$	100	94	58	175	5	15
$S_{20}XP_{200}$	100	95	59	178	5	15
$S_{25}XP_0$	100	99	61	183	5	16
$S_{25}XP_{100}$	100	101	63	188	5	16
$S_{25}XP_{150}$	100	108	64	191	5	17
$S_{25}XP_{200}$	100	116	64	191	5	17

Table 4: Effect of seeding density, Phosphorus level on Dry matter yield (t/ha), Moisture contents Dry Matter, Crude Protein, Crude Fiber, Ash and Ether Extract.

Treatment	Dry Matter Yield	Moisture contents	Dry Matter	Crude Protein	Crude Fiber	Ash	Ether Extract
	Tons ha^{-1}			%			
$S_{15}XP_0$	8.06	80.03	19.97	7	12.33	8.42	2.50
$S_{15}XP_{100}$	8.16	80.14	19.86	7	16.37	9.62	2.40
$S_{15}XP_{150}$	8.86	79.83	20.17	7	16.87	10.32	2.37
$S_{15}XP_{200}$	10.81	79.52	20.48	8	17.10	10.59	2.33
$S_{20}XP_0$	11.40	79.19	20.81	8	17.33	10.91	2.23
$S_{20}XP_{100}$	12.27	78.77	21.23	8	17.73	11.03	2.17
$S_{20}XP_{150}$	12.85	78.02	21.98	9	18.00	11.14	2.13
$S_{20}XP_{200}$	13.37	77.43	22.57	9	18.20	11.24	1.97
$S_{25}XP_0$	14.25	76.67	23.33	9	18.41	11.46	1.87
$S_{25}XP_{100}$	15.23	75.76	24.24	9	19.00	11.70	1.77
$S_{25}XP_{150}$	15.63	75.46	24.54	9	19.63	12.00	1.73
$S_{25}XP_{200}$	16.04	74.85	25.15	9	19.97	12.06	1.63



Picture 1: Effect of seeding density, Phosphorus level on germination%, Plant height (cm), Green Fodder yield (t/ha), Fresh weight (kg per plot), No. of leaves per plant & No. of tillers per plant.

Picture 2: preparation of layout plots and flood irrigation

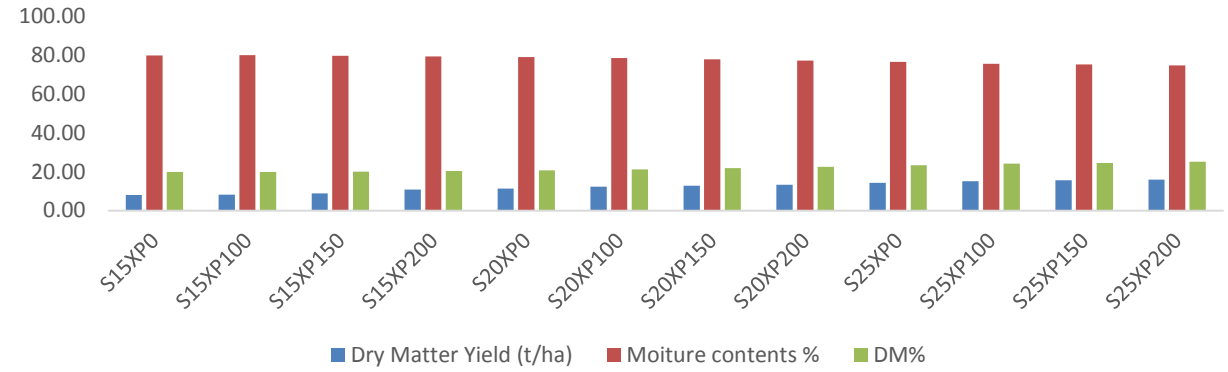
Picture 3: Weighing of seed and fertilizers.

Picture-4: Application of treatments & weeding

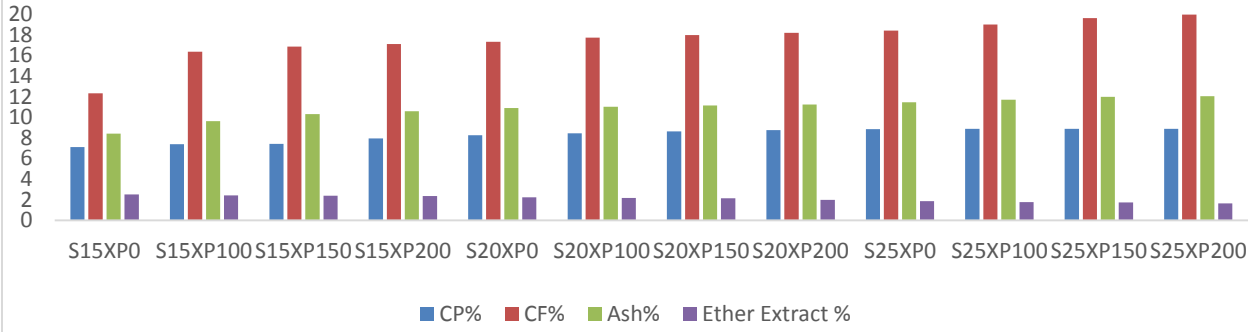
Picture 5: weeding and crop stand of Ryegrass.

Picture 6: Harvesting of ryegrass.

Picture:-7. Effect of seeding density, Phosphorus level on Dry matter yield (t/ha), Moisture contents (%) & Dry Matter (%),



Picture:-8 Effect of seeding density, Phosphorus level on Crude Protein (%), Crude Fiber (%), Ash (%) and Ether Extract %



The result on the organic matter % given in table-5 depicts that the maximum organic matter (%) in soil was found where Phosphorus was 200 Kg P_2O_5 ha^{-1} which was 0.94 % while the minimum values of the result were found in treatment T_0 (control) which was 0.80 % respectively. The results are in line with the findings of Sharma *et al.*, (2015) who reported that the mean value of organic carbon (%) of soil was found significant of different levels of N and P. It was also observed that the organic carbon (%) of soil gradually increased with an increase in doses of N and P. The interaction effect N and P on organic carbon (%) of soil was also found significantly. Similarly, Yun Xia *et al*;2024, reported that additional P input significantly accelerated Soil Organic Carbon mineralization, which could hamper soil Carbon sequestration, especially in subtropical forest soils where P is scarce. This may be attributed to increased microbial activity and DOC concentrations after P addition. First, P addition improved soil conditions for microbial growth by increasing soil pH and P availability, which enhanced microbial biomass and enzymatic activities and consequently stimulated Soil Organic Cabon mineralization which indirectly increased the soil organic matter %.

The result on Phosphorus availability (ppm) given in table-5 depicts that the maximum Phosphorus availability (ppm) in soil was found where Phosphorus was 200 Kg P_2O_5 ha^{-1} which was 13.90 ppm while the minimum values of the result were found in treatment T_0 (control) which was 10.10 ppm respectively. The results are in conformity with the findings of Bati Dube1& Achalu Chimdi; 2021. who reported that the residual soil P after harvest of the maize ranged from 1.312 with no P_2O_5 to 11.79 ppm was recorded at application of 69 kg P_2O_5 ha^{-1}.

The result on the Potassium availability (ppm) given in table-5 depicts that the Potassium availability (ppm) in soil decreased with increasing level of Phosphorus application rates. It was found that the maximum Potassium availability (ppm) was found where No Phosphorus was applied while the minimum Potassium availability (ppm) was achieved where Phosphorus was applied 200 Kg P_2O_5 ha^{-1}. The results are in line with the findings of Habtam Setu, 2022, who reported that the increased phosphorus application

dramatically lowered available potassium. The exchangeable potassium was lowered by around 9 % when the phosphorus rate was increased from zero to 46 kg P_2O_5 ha^{-1}. However, the decrease in exchangeable potassium among phosphorus-treated soils was not statistically significant. However, raising the phosphorus content from 0 to 92 Kg P_2O_5 ha^{-1} reduced the CEC by around 5.5%. However, plots that got 46 and 184 Kg P_2O_5 ha^{-1}were statistically equivalent to plots that received no phosphorus. Saturation % increases with increasing level of phosphorus.

Table 5: Soil Fertility status after harvesting the crop

Phosphorus application rate (kg P_2 O_5)	EC dsm^{-1}	pH	Organic Matter %	Available Phosphorus (ppm)	Extractable Potassium (ppm)
P_0	1.31	9.3	0.80	10.10	67.00
P_{100}	1.33	9.3	0.87	10.40	65.00
P_{150}	1.34	9.8	0.87	10.80	65.00
P_{200}	1.37	10.0	0.94	13.90	63.00

Statistical Analysis: Analysis of variance was performed using Proc GLM procedure of SAS version 9.4 (SAS. 2017) and significant mean differences were tested using Fisher's protected least significant difference (LSD) test at $\alpha = 0.05$.

Conclusion: It was concluded that at seed density 25 kg ha^{-1} and Phosphorus application level of 200 Kg P_2O_5 ha^{-1} gave more green fodder yield i.e. 64 t ha^{-1} & Crude protein 9% in Ryegrass under the prevailing environmental conditions of Okara, Punjab, Pakistan and soil available Phosphorus in solution form was 13.90 ppm.

REFERENCES

Ankit Tiwari, Shivam Singh, Himanshu Panday, Rahul Kumar Rai, Rajat Kumar Maurya and Pramod Kumar;2023. A Review on response of various nitrogen levels and plant density on green forage yield, quality and economics of makkhan grass (*Lolium multiflorum* L.) Intern. J. Stati. and Appl. Mathe. SP-8(4): 314-319.

Arif, M., S. Ali, A. Shah, N. Javeed and A. Rashid; 2005. Seed priming maize for improving emergence and seedling growth. Sarhad J. Agric., 21: 539-543.

Aroosa Kanwal, Dawood Zubair, Rao Mehboob ur Rehman, Muhammad Ibrahim, Muhammad Amjad Bashir, Muhammad Mudassar Maqbool, Muhammad Imran, Ubaid ur Rehman, Omaima Nasif, and Mohammad Javed Ansari; 2022. The Impact of Seeding Density and Nitrogen Rates on Forage Yield and Quality of oats (*Avena sativa* L). BioMed Res. Inter. Article ID 8238634, 9 pages https://doi.org/10.1155/2022/8238634.

Bati Dube & Achalu;2021. Effects of Phosphorus Fertilizer Rates and Its Placement Methods on Residual Soil Phosphorus, Yield, and Phosphorus Uptake of Maize. Americ. J. Agri. and Forestry.9(5):319-333.

Bray, C.M., P.A. Davison, M. Ashraf and R.M. Taylor;1989. Biochemical changes during osmom- priming of leek seeds. Ann. Bot., 63: 185-193.

Gezahagn Kebede, Walelign Worku, Habte Jifar & Fekede Feyissa; 2024. Effects of fertilizer levels and varieties on fodder yield productivity, nutrient use efficiency, and profitability of oat (*Avena sativa* L.) in the central highlands of Ethiopia. J.Agri.& Food Res.Vol (16).

Habtam Setu: 2022.Effect of Phosphorus and Potassium Fertilizers Application on Soil Chemical Characteristics and Their Accumulation in Potato Plant Tissues. Hindawi Appl. & Environ. Soil Scie. Volume 2022, 8 pages. https://doi.org /10.1155/ 2022/ 5342170

Harphool Meena, R.S. Narolia, Pratap Singh, P.K.P. Meena and B.L. Kumhar;2017. Performance of Makhangrass (*Lolium multiflorum* L) under Various Seed Rate in South East Rajasthan, India. Int. J. Curr. Microbiol. App. Sci. 6(5):1945-1950. https: //doi. org/ 10. 20546/ ijcmas.2017.605.216.

Hongli Huang , Rule Zhao , Guanlin Guo , Yinhai He , Shuofu Chen , Yichun Zhu , Mingjun Xiao , Ping Liu , Junwu Liu , Yingchun Fang & Yaoyu Zhou; 2024 Effect of various phosphorus levels on the extraction of Cd, the transformation of P, and phosphorus-related gene during the phytoremediation of Cd contaminated soil. Environ Res. Jun 15;251(Pt 1):118389. doi: 10.1016/j.envres.2024.118389.

https://www.google.com/search?q =Effect+of+ Phosphorus +rates +on+ soil+pH.

Iqbal. M.F., M. A. Sufyan, M. M. Aziz , I. A. Zahid, Qamir-ul-Ghani and S. Aslam; 2009. Efficacy of Nitrogen on green Fodder yield and quality of

Oat (*Avena sativa* L.) J.Ani. & Plant Scie. 19(2): P: 82-84 ISSN: 1018-7081 82.

Mahmut Kamacı and Abdullah Özköse; 2024. The Effect of Different Doses of Nitrogen and Mixtures with Berseem Clover on Yield and Quality of Italian Ryegrass (*Lolium multiflorum* L) . Pol. J. Environ. Stud. Vol. 33, No. 1, 711-719. DOI: 10.15244/pjoes/172030.

Munir A. TURK, Abdel R.M. TAWAHA and Nizar SAMARA ; 2003. Effects of seeding rate and date and phosphorus application on growth and yield of narbon vetch (*Vicia narbonensis*).Agronomie (23) 355–358 355.

Sarat Sekhar Bora, Karuna K. Sharma, Karishma Borah and Milon Jyoti Konwar; 2019. Effect of Nitrogen Levels and Seed Rate on Growth and Yield of Ryegrass (*Lolium multiflorum* L) in Assam, India. Int. J. Curr. Microbial. App. Sci. 8(09): 2110-2114. (doi: https:// doi.org/ 10.20546/ ijcmas.2019.809.244.

Satpal, Y. Jindal, Sarita Devi., J. Tokas, K. K. Bhardwaj and Bishan Singh; 2022. Herbage Yield and Quality of Ryegrass *(Lolium Multiflorum* L) as Influenced by Nitrogen and Phosphorus Management. J. Agric. Res. Technol., 47 (3) : 373-378

Tarun Kumar, Narendra Swaroop, P. Smriti Rao and Tarence Thomas;2019. Effect of different levels of nitrogen and phosphorus on Physico-Chemical properties of soil in maize (Zea mays L.) Cv. K-64. Inter. J. of Chemi. Studies; 7(3): 1910-1914.

Yun Xia, Josep Peñuelas, Jordi Sardans, Xiaojian Zhong, Linglin Xu, Zhijie Yang, Yusheng Yang, Liuming Yang, Kai Yue, Yuexin Fan; 2024.Phosphorus addition accelerates soil organic carbon mineralization by desorbing organic carbon and increasing microbial activity in subtropical forest soils. Appl. soil ecolog. vol. (193).