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PC Patil
Student (M. Sc. Agriculture), Department of Agronomy, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

SS Ilhe
Professor of Agronomy, Post Graduate Institute Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

NJ Danawale
Chief Scientist (Seeds), Seed cell, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

AG Durgude
Associate Professor of Irrigation and Water Management, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

MR Patil
Professor of Statistics Mathematics, Department of Statistics, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

Corresponding Author:
PC Patil
Student (M. Sc. Agriculture), Department of Agronomy, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India

Effect of phosphate rich organic manure (Prom) on *kharif* sweet corn (*Zea mays* L. *var*. *Saccharata*)

PC Patil, SS Ilhe, NJ Danawale, AG Durgude and MR Patil

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Abstract
A field investigation entitled "Effect of phosphate rich organic manure (PROM) on *kharif* sweet corn (*Zea mays* L. *var*. *Saccharata*)" was conducted in *Kharif* season of 2023-2024 at the Instructional farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The experiment was laid out in Randomized Block Design (RBD) with three replications and seven treatments *viz.*, T_1: Absolute Control, T_2: Control (No P_2O_5), T_3: 100% P through Single Super Phosphate (SSP), T_4: 100% P through Phosphate Rich Organic Manure (PROM), T_5: 75% P through Phosphate rich organic manure (PROM) + 25% P through Single Super Phosphate (SSP), T_6: 50% P through Phosphate rich organic manure (PROM) + 50% P through Single Super Phosphate (SSP), T_7: 25% P through Phosphate rich organic manure (PROM) + 75% P through Single Super Phosphate (SSP). The soil of the experimental plot was clayey in texture, low in available nitrogen (196.56 kg ha^{-1}), high in available phosphorus (22.82 kg ha^{-1}), high in available potassium (342.23 kg ha^{-1}) and slightly alkaline in reaction (pH 7.6). The EC and organic carbon content was 0.47 dS m^{-1} and 0.53% respectively. The application of 100% P through Single Super Phosphate (SSP) exhibited significantly higher plant height (178.40 cm), number of functional leaves $plant^{-1}$ (13.83), leaf area $plant^{-1}$ (33.33 dm^2) and dry matter $plant^{-1}$ (255.70 g) at harvest as compared to rest of nutrient management during *kharif* 2023- 24. This treatment was found significant but at par with the application of 25% P through Phosphate rich organic manure (PROM) + 75% P through Single Super Phosphate (SSP) recorded plant height (176.20 cm), number of functional leaves $plant^{-1}$ (12.40), leaf area $plant^{-1}$ (31.67 dm^2) and dry matter $plant^{-1}$ (253.67 g) at harvest and 50% P through Phosphate rich organic manure (PROM) + 50% P through Single Super Phosphate (SSP) recorded plant height (175.50 cm), number of functional leaves $plant^{-1}$ (12.33), leaf area $plant^{-1}$ (30.60 dm^2) and dry matter $plant^{-1}$ (252.83 g) at harvest. The application of 100% P through Single Super Phosphate (SSP) exhibited significantly higher green cob yield (246.00 q ha^{-1}), and green fodder yield (456.00 q ha^{-1}), gross monetary returns (₹ 249720 ha^{-1}), net monetary returns (₹ 169429 ha^{-1}) and benefit: cost ratio (3.11).

Keywords: Sweet corn, yield, economics, phosphate rich organic manure (PROM)

Introduction
Agriculture is the backbone of the Indian economy, contributing 18.2% to the country's GDP (Anonymous, 2023) [3] and supporting the livelihoods of approximately 42.3% of the population, including those engaged in allied sectors like livestock, poultry, and fisheries. Cereals, which belong to the poaceae family, play a vital role globally, with around half of the world's arable land dedicated to their cultivation. These crops, including wheat, rice, corn, barley, oats, rye, sorghum, and millets, provide 56% of global food energy and 50% of global protein. The top three cereals - wheat, rice, and corn - dominate global production, accounting for three-quarters of total output, while sorghum, barley, millets, rye, and oats make up the remaining share of global cereal production.

The maize crop is cultivated throughout the year in all states of the India for various purposes including grain, fodder, sweet corn, baby corn, pop-corn in peri-urban areas. Among the speciality corns, sweet corn has gaining popularity both in urban and rural areas because of it's high sugar and low starch content. It is important in urban areas due to it's taste and other uses for human consumption. Thus the increase in production and productivity of sweet corn will be a desirable attribute in facilitating diversified utilization through human consumption of fresh kernels as well as processed food.

Finely decomposed organic matter with Carbon to Nitrogen ratio of 20: 1 (C: N) is an essential criteria for PROM production. As improperly decomposed organic matter fights with the crops for soil nutrients and leads to the growth of detrimental termites (Aechra *et al*., 2021) [1]. In India, significantly lower available P content is observed in soil thus leading to reduced fertility and yield. Microbes that decompose organic matter generate a diversity of beneficial molecules for example gibberlins, auxins, vitamins, fulvic and humic acids, which are important for the plant growth. Hence, chemical based fertilizers and minerals cannot substitute organic manure in crop production. Organic matter enriched with humic acid and other growth promoting molecules, improves soil fertility in multiple ways, viz. enhances soil structure, texture, aeration, and water holding capacity, etc.

Materials and Methods

The field experiment was conducted at the Instructional farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist. Ahmednagar during *kharif* season of 2023-24. The soil in the experimental field belongs to Inceptisol order and medium deep soil with a depth of more than 60 cm and the topography is uniform and levelled. For the assessment of initial soil fertility status, representative initial soil samples were taken. These soil samples were properly mixed and a composite soil sample was collected and evaluated for physical and chemical soil parameters. The soil of the experimental plot was clayey in texture, low in available nitrogen (196.56 kg ha^{-1}), high in available phosphorus (22.82 kg ha^{-1}), high in available potassium (342.23 kg ha^{-1}) and slightly alkaline in reaction (pH 7.6). The EC and organic carbon content was 0.47 dS m^{-1} and 0.53% respectively. Geographically, the Instructional Farm of PGI, MPKV, Rahuri lies on the elevation of 495 to 569 m above sea level. It is situated between 19^0 48' and 19^0 57' North latitude and 74^0 10' and 74^0 32' East longitude. Agro climatically, this area is located in rain scarcity zone of Maharashtra (drought prone area). Monsoon season usually begins in the third week of June and ends in the last week of September, with yearly rainfall ranging from 307 to 619 mm, with an average rainfall of 520 mm. The climatic conditions were favorable for sweet corn growth and development, according to the meteorological data.

The experiment was laid out in a randomized block design with three replications. Eight different treatment combinations were created. The seeds of sweet corn variety Sugar 75 were obtained from Syngenta pvt. ltd. Sowing was done on 18th July 2022 by dibbling two seeds at each hill at recommended spacing 60 cm x 20 cm. Harvesting was done manually at physiological maturity of crop.

Results and Discussion

Growth Characters

Plant Height

The plant height was increased progressively with the age progression of the plant due to continuous growth habit of sweet corn. Initially, the plant height was at less up to 30 DAS. The plant growth rate in terms of plant height was rapid from 30 DAS to 60 DAS. The plant height was significantly influenced due to different level of phosphate rich organic manure (PROM) treatments in sweet corn.

The sweet corn applied with 100% P through Single Super Phosphate (T_3) registered significantly higher plant height at 30, 45, 60 and at harvest was (36.53, 99.89, 161.28 and 178.40 cm respectively) at all growth stages of sweet corn. However, it was at par with the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (T_7) (35.66, 99.10, 158.50 and 176.20 cm respectively) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (T_6) (35.32, 98.20, 157.33 and 175.50 cm respectively) at 45 DAS, 60 DAS and harvest of sweet corn. Whereas the significantly minimum plant height (30.86, 94.00, 151.50 and 169.20 cm respectively) at all growth stages of sweet corn was recorded in the treatment absolute control (T_1), where no fertilizers were applied.

Number of Functional Leaves

The mean number of leaves $plant^{-1}$ was 6.19, 10.76, 13.62 and 11.87 recorded at 30, 45, 60 and at harvest respectively.

The data in respect of number of leaves $plant^{-1}$ in sweet corn were influenced significantly due to different nutrient combinations at all growth stages. The sweet corn crop applied with 100% P through Single Super Phosphate (T_3) registered significantly higher number of leaves $plant^{-1}$ (7.27, 12.63, 15.07 and 13.83 respectively) at all growth stages of sweet corn. However, it was at par with the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (T_7) treatment recorded number of leaves $plant^{-1}$ (6.87, 11.67, 14.33 and 12.40 respectively) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (T_6) treatment recorded number of leaves $plant^{-1}$ (6.47, 11.13, 13.83 and 12.33 respectively) at all growth stages of sweet corn. Whereas the significantly minimum number of leaves $plant^{-1}$ was (5.50, 9.63, 12.33 and 10.03 respectively) at all growth stages of sweet corn was recorded in the treatment absolute control (T_1), where no fertilizers were applied.

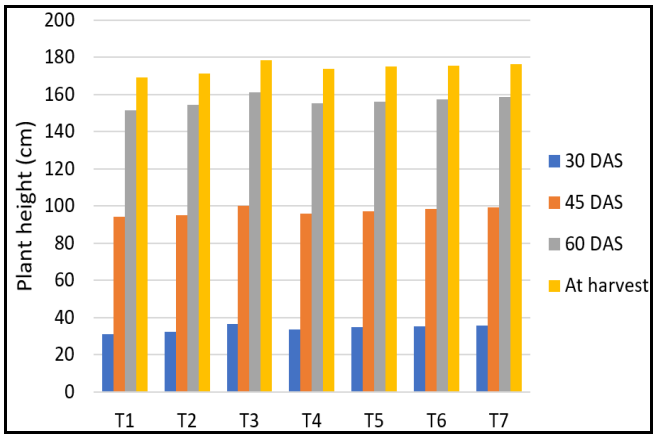

Fig 1: Plant Height

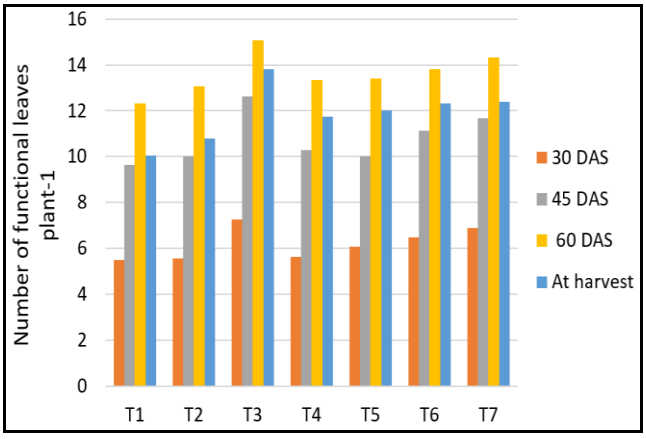

Fig 2: Number of Functional Leaves

Yield Characters

Weight of cob with husk and without husk

The data in respect of weight of cob with husk and without husk of sweet corn as influenced by different treatments during *kharif* season, 2023 are presented in table 1. The mean weight of cob with husk and without husk of sweet corn (269.32 g and 228.25 g, respectively) was obtained during present investigation.

The data in respect of cob weight with husk and without husk of sweet corn was influenced significantly due to different nutrient combinations at harvest. The sweet corn crop fertilized with 100% P through Single Super Phosphate (SSP) produced significantly maximum cob weight with husk (292.33 g) and without husk (248.93 g) as compared to rest of the treatments. However, the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP) with cob weight with husk (287.00 g) and without husk (244.00 g) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP) with cob weight with husk (284.93 g) and without husk (240.83 g) were found at par with it at harvest of sweet corn. Whereas, the significantly minimum cob weight with husk (232.37 g) and without husk (187.97 g) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Mali *et al*., (2017) [5], Mohammadi *et al*., (2017) [7], Singh *et al*., (2018) [9] all discovered that the increased fresh weight of the cob could have been attributed to the function of phosphorous in photosynthesis and energy production, as well as the uptake and transfer of photosynthates from leaves to the sink.

Diameter of cob with husk and without husk

The data in respect of diameter of cob with husk and without husk of sweet corn as influenced by different treatments during *kharif* season, 2023 are presented in table 1. The mean diameter of cob with husk and without husk of sweet corn (21.09 cm and 18.36 cm, respectively) was obtained during investigation.

The data related to diameter of cob with husk and without husk of sweet corn was influenced significantly due to different treatments at harvest. The sweet corn crop fertilized with 100% P through Single Super Phosphate (SSP) produced significantly maximum cob diameter with husk (24.20 cm) and without husk (21.53 cm) as compared to rest of the treatments. However, the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP) with cob diameter with husk (22.63 cm) and without husk (19.83 cm) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP) with cob diameter with husk (21.49 cm) and without husk (19.18 cm) were found at par with it at harvest of sweet corn. Whereas, the significantly minimum cob diameter with husk (18.33 cm) and without husk (15.33 cm) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Based on the continuous availability of balanced nutrients to the plant, it improved diameter of cob, according to Mali *et al*., (2017) [5], Mohammadi *et al*., (2017) [7], Singh *et al*., (2018) [9].

Table 1: Weight of cob with husk and without husk, diameter of cob with husk and without husk and green cob yield of sweet corn as influenced by different treatments

Tr. No.	Treatment	Cob weight with husk (g)	Cob weight without husk (g)	Cob diameter with husk (cm)	Cob diameter without husk (cm)	Green cob yield (q ha^{-1})
T_1	Absolute control	232.37	187.97	18.33	15.33	139.33
T_2	Control (No P_2O_5)	248.33	217.00	19.93	16.93	197.00
T_3	100% P through Single Super Phosphate (SSP)	292.33	248.93	24.20	21.53	246.00
T_4	100% P through Phosphate Rich Organic Manure (PROM)	264.67	225.00	20.67	17.70	218.33
T_5	75% P through Phosphate Rich Organic Manure (PROM) and 25% P through Single Super Phosphate (SSP)	275.67	234.00	20.70	18.03	230.67
T_6	50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP)	284.93	240.83	21.49	19.18	237.33
T_7	25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP)	287.00	244.00	22.63	19.83	242.00
	S. E. (m)±	2.62	2.71	0.92	0.77	2.96
	CD (P=0.05)	8.07	8.34	2.84	2.37	9.14
	General mean	269.32	228.25	21.09	18.36	215.81

Green cob yield

The data in respect of green cob yield of sweet corn as influenced by different treatments during *kharif* season, 2023 are presented in table 1. The mean green cob yield of sweet corn (215.81 q ha^{-1}) was obtained during investigation.

The data related to green fodder yield of sweet corn was influenced significantly due to different treatments at harvest. The sweet corn crop fertilized with 100% P through Single Super Phosphate (SSP) produced significantly maximum green fodder yield (456.00 q ha^{-1}) as compared to rest of the treatments. However, the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP) with green fodder yield (447.67 q ha^{-1}) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP) with green fodder yield (437.33 q ha^{-1}) were found at par with it at harvest of sweet corn. Whereas, the significantly minimum green fodder yield (244.74 q ha^{-1}) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation.

The sweet corn applied with 100% P through Single Super Phosphate (SSP) offered easy availability for the absorption of primary and secondary macro nutrients in higher amount. The macro and micronutrients played role in translocation of photosynthates from source to vegetative part of sweet corn and the overall effect of all nutrients on yield parameters was positive which intern produce higher green fodder yield. The same findings were also reported by Mohammadi *et al*., (2017) [7], Singh *et al*., (2018) [9].

Economic studies

The economic evaluation of sweet corn crop was assessed in terms of gross monetary returns, cost of cultivation, net monetary returns and benefit cost ratio during *kharif* season of 2022-23 are presented in table 2.

Gross monetary returns

The mean gross monetary returns of sweet corn crop obtained during *kharif* 2023- 24 was (₹ 215971.3 ha^{-1}). The gross monetary returns of sweet corn crop were influenced significantly due to different treatments. The sweet corn crop fertilized with 100% P through Single Super Phosphate (SSP) found superior and obtained significantly maximum gross monetary returns ₹ 249720 ha^{-1} than other treatments. However, the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP) with gross monetary returns (₹ 245504 ha^{-1}) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP) with gross monetary returns (₹ 240477 ha^{-1}) were found at par with it. Whereas the significantly minimum gross monetary returns (₹ 139137 ha^{-1}) were recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Sanaye *et al*., Mali *et al*., (2017) [5] and Majeed *et al*., (2022) [4].

Net monetary returns

The mean net monetary returns of sweet corn crop obtained during *kharif* 2023- 24 was (₹ 137892 ha^{-1}). The net monetary returns of sweet corn crop were influenced significantly due to different treatments. The sweet corn crop fertilized with 100% P through Single Super Phosphate (SSP) found superior and obtained significantly maximum net monetary returns ₹ 169429 ha^{-1} than other treatments. However, the treatment 25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP) with net monetary returns (₹ 164175 ha^{-1}) and 50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP) with net monetary returns (₹ 158619 ha^{-1}) were found at par with it. Whereas the significantly minimum net monetary returns (₹ 78383 ha^{-1}) were recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Sanaye *et al*., Mali *et al*., (2017) [5] and Majeed *et al*., (2022) [4].

Table 2: Economics of sweet corn as influenced by different treatments

Tr. No.	Treatment	Gross monetary return (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net monetary return (₹ ha^{-1})	B: C ratio
T_1	Absolute control	139137	60754	78383	2.29
T_2	Control (No P_2O_5)	191025	75491	115534	2.53
T_3	100% P through Single Super Phosphate (SSP)	249720	80291	169429	3.11
T_4	100% P through Phosphate Rich Organic Manure (PROM)	215901	83935	131966	2.57
T_5	75% P through Phosphate Rich Organic Manure (PROM) and 25% P through Single Super Phosphate (SSP)	230035	82896	147139	2.77
T_6	50% P through Phosphate Rich Organic Manure (PROM) and 50% P through Single Super Phosphate (SSP)	240477	81858	158619	2.93
T_7	25% P through Phosphate Rich Organic Manure (PROM) and 75% P through Single Super Phosphate (SSP)	245504	81329	164175	3.01
	S. E. (m)±	4193	-	4193	-
	CD (P=0.05)	12922	-	12922	-
	General mean	215971.3	78079.14	137892	2.74

Cost of cultivation

The mean cost of cultivation of sweet corn crop obtained during *kharif* 2023-24 was (₹ 78079.14 ha^{-1}). The sweet corn crop fertilized with 100% P through Phosphate Rich Organic Manure (PROM) recorded maximum cost of cultivation (₹ 83935 ha^{-1}) than other treatments. However, the minimum cost of cultivation (₹ 60754) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Sanaye *et al*., Mali *et al*., (2017) [5] and Majeed *et al*., (2022) [4].

Benefit: cost ratio

The mean benefit cost ratio of sweet corn crop obtained during *kharif* 2023-24 was (2.74). The sweet corn crop fertilized with 100% P through Single Super Phosphate (SSP) recorded maximum benefit cost ratio (3.11) than other treatments. However, the minimum benefit cost ratio (2.29) was recorded in the treatment absolute control, where no fertilizers were applied during the experimentation. Similar findings were recorded by Sanaye *et al*., Mali *et al*., (2017) [5] and Majeed *et al*., (2022) [4].

Conclusion

The application of GRDF (120: 60: 40 N: P_2O_5: K_2O Kg ha^{-1} + FYM 10 t ha^{-1}) along with soil application of 100% P through Single Super Phosphate (SSP) to sweet corn crop found beneficial for increase of yield attributes, yield and economic returns grown on medium deep soil.

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