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Impact of NPK doses on post harvest observations and yield attributes of different varieties of grain sorghum (*Sorghum bicolor* L.)

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Abstract
The experiment was carried out during the *kharif* 2024 under the All India Co-ordinated Sorghum Improvement Project at R.V.S.K.V.V., College of Agriculture, Indore (M.P.).A field experiment was laid out in a SPD (Split Plot Design) comprising with four Main plot treatment (Fertilizer dose) and ten sub plot treatment (varieties).Based on conducted research the highest result of Post harvest observations and Yield attributes-No. of cobs (per m2), Length of cob (cm), Weight of per cob (g), No. of grains per cob found under F_4 N:P:K 120: 60: 60 along with variety SPH-2024 V_9 respectively.

Keywords: Post harvest observations, SPD, variety

Introduction
Sorghum (*Sorghum bicolor* L. Moench) is a C4 plant that belongs to the Poaceae family. It is the fifth most significant cereal crop worldwide, after rice, wheat, maize and barley. It is commonly referred to as jowar, great millet, *cholam* and *jonna*. In India, it is the 3rd most important cereal crop, following rice and wheat. It is a vital crop for millions of farmers in the semi-arid tropics of India. It is re-emerging as a potential alternative food, feed, fodder and bioenergy crop (Naik *et al.*, 2018) [3]. Globally, sorghum produced during 2023-24 is about 52.80 million tonnes (MT). United States stands top with producing 8.07 MT (14%), followed by Nigeria with 6.70 MT (11%), Brazil with 4.76 MT (8%) and India with 4.40 MT (8%). India ranks 4th in total sorghum production with 4.40 MT tonnes grown in an area of 3.97 million hectares (Mha), and with productivity of 1092 kg ha^{-1}. Maharashtra is the largest sorghum producing state, contributing 34.42%, followed by Karnataka (20.57%), Rajasthan (15.93%) and Madhya Pradesh (5.97%). In Madhya Pradesh, it is grown in an area of 1.42 lakh hectare, with a production of 3.08 lakh tonnes with productivity of 1919 kg ha^{-1} (Anonymous, 2023) [1].

Its grains are mainly used as a raw material in beer industry, in making starch, poultry feeds and other milled products. It is used in making jaggery, sugar and industrial alcohol (Roby *et al.*, 2017) [5].

Lower productivity of sorghum due to lower doses of NPK (nitrogen, phosphorus and potassium) occurs because these nutrients are essential for the plant's growth and development. Nitrogen promotes leaf growth and plays a key role in the photosynthesis process, phosphorus aids in root development and energy transfer, while potassium enhances water regulation and disease resistance. Lower application of NPK results in stunted growth, poor root development, chlorosis (yellowing of leaves), weak stems and reduced flowering and fruiting. This leads to lower biomass production and significantly reduced grain yield, highlighting the importance of proper nutrient management to achieve optimal sorghum productivity (Hailu and Kedir, 2022) [2].

The use of chemical fertilizers has helped increase crop production to meet the growing food demand. However, their excessive use can harm soil health and the environment. While they provide important nutrients for plants, too much fertilizer can lead to problems like soil damage, nutrient loss and the disruption of beneficial soil microbes.

Overuse can also cause soil to become compacted, reduce water flow and increase erosion, which lowers soil productivity (Pradhan *et al.*, 2023) [4].

According to Sharma and Gupta (2020) [6] for high-yielding sorghum in Madhya Pradesh, apply 120 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare. Nitrogen should be split, with 50% at sowing and the remaining 50%, 30 days after sowing, while phosphorus and potassium are applied entirely at sowing.

Materials and Methods

The experiment was carried out during the *kharif* 2024 under the All India Co-ordinated Sorghum Improvement Project at R.V.S.K.V.V., College of Agriculture, Indore (M.P.). Indore is located at the Malwa Plateau in the western part of Madhya Pradesh, at a latitude of 22.43° N and longitude of 75.66° E, with an elevation of 553.0 meters above sea level. To maintain proper tilth, the experimental field was ploughed once using a tractor-drawn mould board plough, followed by one cross harrowing and planking. Following that, the field was divided into individual plots according to the layout design, with adequate irrigation and drainage channels for removal of excess rain water. Sorghum varieties PYPS-2, CSV-50R, SPH-2010, SPV-3003, SPV-2976, CSV-41, CSH-41, SPH-2021, SPH-2024 and SPV-3006 were sown in rows on July 2, 2024, with a seed rate of 12 kg ha^{-1}, 45 x 10 cm row-to-row and plant-to-plant distance, and fertility levels of 0 (Control), 50, 100 and 150% RDF (recommended dose of fertilizer 80 kg N + 40 kg P_2O_5 + 40 kg K_2O ha^{-1}).Thinning and gap filling were carried out at 15 DAS after seed germination to ensure the crop maintained an optimal plant population. Pendimethalin 30% EC (1.5 lit. ha^{-1}) was applied as a pre-emergence spray to control mainly broadleaf weeds. Additionally, two manual hoeing sessions were carried out, followed by one manual seeding at 30 days after sowing using a *Khurpi*, to ensure proper aeration and conserve soil moisture

Results and Discussion

Post harvest observations and Yield attributes

No. of cobs (m^{-2})

The data observed in the no. of cobs of grain sorghum is presented in Table 1. It is obvious from the data that the minimum no. of cobs (14.27 m^{-2}) was achieved where no NPK were applied. The no. of cobs was further increase with the increasing doses of NPK and found as (15.22 and 16.32 m^{-2}) with the application of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O and 80 kg N, 40 kg P_2O_5 and 40 kg K_2O, respectively, and found the maximum no. of cobs (17.24 m^{-2}) with the application of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O.

Among the different varieties the minimum no. of cobs (15.41 m-2) was found in SPV-2976, followed by PYPS-2 (15.52 m-2). Whereas the maximum no. of cobs (16.20 m-2) was found in SPH-2024, followed by CSV-41 (16.09 m-2).

Table 1: Effect of different NPK doses in grain sorghum varieties on no. of cobs (m-2).

Treatment details (N: P_2O_5: K_2O in kg ha^{-1})	No. of cobs (m-2)
0: 0: 0	14.27
40: 20: 20	15.22
80: 40: 40	16.32
120: 60: 60	17.24
SEm±	0.03
C.D. (5%)	0.11
PYPS-2	15.52
CSV-50R	15.66
SPH-2010	15.69
SPV-3003	15.72
SPV-2976	15.41
CSV-41	16.09
CSH-41	15.94
SPH-2021	15.86
SPH-2024	16.20
SPV-3006	15.53
SEm±	0.03
C.D. (5%)	0.09
Interaction F x V	0.29

Length of cob (cm)

The data recorded in the length of cob of grain sorghum is presented in Table 2. It is obvious from the data that the minimum length of cob (18.03 cm) was obtained where no NPK were applied. The length of cob was further increase with the increasing doses of NPK and found as (21.21 and 23.46 cm) with the application of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O and 80 kg N, 40 kg P_2O_5 and 40 kg K_2O, respectively, and found the maximum length of cob (26.43 cm) with the application of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O.

Among the different varieties the minimum length of cob (21.66 cm) was found in SPV-2976, followed by PYPS-2 (21.81 cm). Whereas the maximum length of cob (23.15 cm) was found in SPH-2024, followed by CSV-41 (22.86 cm).

Weight of cob (g/cob)

The data recorded in the weight of cob of grain sorghum is presented in Table 2 It is obvious from the data that the minimum weight of cob (47.70 g/cob) was obtained where no NPK were applied. The weight of cob was further increase with the increasing doses of NPK and found as (52.70 and 63.87 g/cob) with the application of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O and 80 kg N, 40 kg P_2O_5 and 40 kg K_2O, respectively, and found the maximum weight of cob (78.05 g/cob) with the application of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O.

Among the different varieties the minimum weight of cob (58.02 g/cob) was found in CSV-50R, followed by SPH-2010 (58.46 g/cob). Whereas the maximum weight of cob

(64.89 g/cob) was found in SPH-2024, followed by SPH-2021 (63.58 g/cob).

Table 2: Effect of different NPK doses in grain sorghum varieties on length of cob (cm) and weight of cob (g/cob)

Treatment details (N: P_2O_5: K_2O in kg ha^{-1})	Length of cob (cm)	Weight of cob (g/cob)
0: 0: 0	18.03	47.70
40: 20: 20	21.21	52.70
80: 40: 40	23.46	63.87
120: 60: 60	26.43	78.05
SEm±	0.06	0.05
C.D. (5%)	0.21	0.16
PYPS-2	21.81	59.71
CSV-50R	22.02	58.02
SPH-2010	22.04	58.46
SPV-3003	22.07	58.62
SPV-2976	21.66	60.67
CSV-41	22.86	59.11
CSH-41	22.68	62.81
SPH-2021	22.46	63.58
SPH-2024	23.15	64.89
SPV-3006	22.07	59.93
SEm±	0.10	0.15
C.D. (5%)	0.29	0.41
Interaction F x V	NS	0.83

No. of grains per cob

The data noted in the no. of grains of grain sorghum is presented in Table 3. It is obvious from the data that the minimum no. of grains (1459.66 cob^{-1}) was achieved where no NPK were applied. The no. of grains was further increase with the increasing doses of NPK and found as (1645.00 and 1916.07 cob^{-1}) with the application of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O and 80 kg N, 40 kg P_2O_5 and 40 kg K_2O, respectively, and found the maximum no. of grains (2460.83 cob^{-1}) with the application of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O.

Among the different varieties the minimum no. of grains (1712.43 cob^{-1}) was observed in CSV-50R, followed by SPH-2010 (1744.24 cob^{-1}). Whereas the maximum no. of grains (2055.45 cob^{-1}) was observed in SPH-2024, followed by SPH-2021 (1995.32 cob^{-1}).

Table 3: Effect of different NPK doses in grain sorghum varieties on no. of grains per cob

Treatment details (N: P_2O_5: K_2O in kg ha^{-1})	No. of grains per cob
0: 0: 0	1459.66
40: 20: 20	1645.00
80: 40: 40	1916.07
120: 60: 60	2460.83
SEm±	5.08
C.D. (5%)	17.93
PYPS-2	1864.07
CSV-50R	1712.43
SPH-2010	1744.24
SPV-3003	1773.82
SPV-2976	1916.06
CSV-41	1819.67
CSH-41	1935.88
SPH-2021	1995.32
SPH-2024	2055.45
SPV-3006	1886.98
SEm±	6.78
C.D. (5%)	19.16
Interaction F x V	39.60

Conclusion

The yield attributes *i.e*., number of cobs, cob length, cob weight, number of grains per cob, were all significantly affected by different NPK doses. The application of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O resulted in the highest number of grains per cob, cob weight, grain weight per cob.Yield attributing and yield characters *i.e*., number of cobs, length of cob, weight of cob, number of grains cob^{-1}, was obtained maximum with variety SPH-2024. The interaction of application of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O with variety SPH-2024 fond the best result respectively.

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