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Research Article

Effect of Phosphorus Fertilizer rates on Grain yield and Yield components of Sorghum (Sorghum bicolor L.) at Kersa District, Jimma Zone, South western Ethiopia

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Abstract

Depletion of soil fertility coupled with low rate of fertilization is one of the major constraints limiting crop yield in Ethiopia. Here therefore, afield experiment was conducted on Nitisols of Kersa District, Southwestern Ethiopia during 2017/18 main cropping season to determine the effect of phosphorus fertilizer rates on grain yield and profitable production of sorghum. The experiment consists of seven levels of P (0, 11.5, 23, 34.5, 46, 57.5 and 69 kg ha- 1P) including one treatment 46 - 40 kg ha-1 PK to evaluate the effect of potassium along with uniform level of 46 kgha-1 N. The experiment was arranged in Randomized Complete Block Design (RCBD) with three replications. The collected data was subjected to ANOVA using SAS 9.3 version software. The results revealed that P fertilization along with K brought significant effect on grain yield, biomass yield and harvest index. The maximum grain yield (4517.0kg ha-1) and biomass yield (7134.3 kgha-1) were obtained from combined fertilization of PK (46-40 kgha-1), while the lowest grain yield (2212.6kgha-1) and biomass yield (5366.4 kgha-1) were recorded from control plots. With regard to harvest index, the maximum value 48.0% was obtained from plots treated with 57.5kgha-1 P, while the lowest value (43.3%) was recorded from control plots. Moreover, application of (46-40 kgha-1) PK produced the maximum net benefits of 23273.23 Birrha-1 with acceptable marginal rate of return 520.18%. Therefore, we can recommend that integrated application of NPK fertilizer at a rate of 46-46-40 kg ha-1 is better than sole P application for improved yield and economical production of sorghum.

Keywords: Economic return; Fertilizer rate; Yield

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Introduction

Sorghum [1] belongs to the family Poaceae which is the fifth most important world cereal crops in production after wheat, rice, maize and barley [2]. It is one of the most important cereal crops grown in arid and semi-arid parts of the world, evolved in semi-arid tropical Africa, India and China where it is still used as a major food grain. Because of its drought resistance and wide range of ecological adaptation, it is the crop of choice for dry regions and areas with low rainfall amount [3]. In most East African countries, sorghum is grown in between an altitude of 900 to 1,500 masl and in Ethiopia the crop grows all over the country across various agro ecologies from high altitude with sufficient amount of rainfall to low lands receiving low rainfall [4,3] According to the report of [5], annually 1.8 million ha of land is allotted for sorghum production and 4.3 million ton of grain is produced in Ethiopia.

Currently, the crop is used as raw material for industries beyond animal feed and human consumption. It is gaining commercial value in malting and brewing industries which indicates, the crop has multi-purposes in lower and mid altitude regions of Ethiopia and it is not only a staple food crop in the rural areas but also it is used primarily to prepare local foods (injera, bread, thick porridge). In Ethiopia, this crop accounts for one-third of the total cereal crops production area and covers 16.36% of the total cultivated area [6] However, the productivity is still very low, where in sorghum dominated areas 11289 kg ha^{-1} was obtained from the nil fertilizer [7]. On the other hand, above 5100 kg ha^{-1} yield was obtained under intensive management in Ethiopia [4]. The major problem for low productivity is declines in the soil fertility due to high soil erosion, blanket application of NP fertilizer are among the major limiting factors to sorghum production.

To increase production of cereal crops, refining the blanket fertilizer recommendation and increasing appropriate use of essential nutrients is an option. Fertilizers are naturally obtained or artificially produced nutrient sources that, when applied on the plant or to soil can supplement natural soil nutrients and augment crop growth and soil fertility for growth and development. Therefore, improving the nutrient content of the fertilizer that fits to the needs of the crops is required to improve the productivity of sorghum.

Among major macronutrients, phosphorus is one of the most important yields limiting plant nutrient next to nitrogen and is the second most deficient plant nutrient in Jimma area [8]. It plays an important role in many physiological processes such as photosynthesis, storage

of energy and its transfer, respiration and cell enlargement, cell division etc. Minimum usage of P in relation to N has been identified as one of the major factors limiting higher crop yields. Therefore, phosphorus deficiency is a yield reducing factor if it not applied in adequate quantity. For instance, previous research findings reported that P deficiency reduces number of tillers and plant leaf area by producing smaller and less number of leaves and at the end overall economy of the crop [9]. On the other hand, when phosphorus fertilizer is in optimum amount, gradually it increases the overall economy of sorghum crop [10]. Despite its importance and high genetic diversity, scientific information about the nutrient requirement of sorghum is not yet exhaustively investigated in the study area. This coupled with the low and decreasing levels of soil fertility particularly soil N and P levels, for sustainable crop production and soil fertility maintenance. Therefore, the present experiment was conducted (i) to evaluate the effect of phosphorus fertilizer rates on grain yield and (ii) to determine economics return of sorghum at Nitisols of Jimma area.

Materials and Methods

Description of study area

A field experiment was conducted on farmers' fields in Nitisols of Kersa District South-western Ethiopia to evaluate the effect of different level of phosphorus and potassium fertilizers on yield of sorghum. The experimental sites was geographically located 7° 42' N latitude, 36º 59' E longitude and at altitude of 1753masl. The average minimum and maximum temperature was 11.6°C and 27.5°C, respectively. The area received an average annual rainfall of 1750 mm. The predominant soil type of the study area is Nitisols which have a reddish brown colour with moderately acidic reaction. On average, the soil is deep and highly weathered well-drained, sandy clay in texture and strong to moderately acidic in a reaction as reported [11]. The farming system of the area is dominated by cereals like maize, tef and sorghum. Soybean is also among the legume crops cultivated in the area.

Soil sampling and laboratory analysis procedures

One representative composite soil sample (0-20cm depth) was collected using an auger before treatment application. The collected sample was air-dried and ground to pass a 2-mm sieve and analyzed for soil pH, soil texture, Organic Carbon (OC), Total Nitrogen (TN), Available Phosphorus (Av. P), available potassium (K), Cation Exchange Capacity (CEC) at Jimma Soil and plant Tissue Analysis Laboratory. The pH-H_2O was measured at 1:2.5 soils to solution suspension using a pH meter. The Walkley and Black method functioned to determine the OC content while the Kjeldahl method was employed to determine total nitrogen Bremner and Mulvaney (1982). Available P was determined using the Bray II method by Bray and Kurtz (1945).

Experimental materials and planting procedures

High yielding Aba Melko sorghum variety which is the most promising hybrid released by Jimma Agricultural Research Centre and adapted to the agro-ecology of the area was used as a test crop. Planting was done based on local farmers planting calendar. Phosphorus was applied once at planting and full doses of recommended nitrogen fertilizer (46kgha^{-1}) were applied in splits half rate at planting and the remaining half dose at knee height. Urea, Triple Super Phosphate (TSP) and Murate of Potash (KCl) were used as sources of fertilizer for supplying N, P and K nutrients, respectively. All cultural practices such as weeding and hoeing were done uniformly to all plots based on the crop's agronomic recommendation. Harvesting was done manually from the net plot area when the crop physiologically matured.

Treatments and experimental design

The experiment consisted seven levels of phosphorus fertilizer (0, 11.5, 23.0, 34.5, 46.0, 57.5, and 69 kg ha^{-1} P) and one satellite treatment (46-40 kg ha^{-1} PK). The treatments were applied with respect to the treatment allocation. In all plots, 46 kgha^{-1} N was applied uniformly. Even though farmers are not growing sorghum without phosphorus fertilizer, control treatment was included for comparison among the rest of the treatments. The treatments were arranged in a Randomized Complete Block Design (RCBD) replicated three times. The experimental plot had gross plot area of 14.625m^2 (3.75m x 3.9m), which accommodated 5 rows while the net plot area was 11.7m^2 (3m x 3.9m). The spacing of 0.15m and 0.75m [12] was used between plants and rows, respectively.

Data collection

Grain yield of sorghum from each net plot were harvested when the crop fully matured. The weighted grain was finally adjusted to (12.5%) which is the standard moisture contents of cereal crops. Biomass yield of sorghum from each harvestable plot was harvested at the ground level from each plot were measured and reported on a hectare basis.

Harvest Index (%) was determined as a ratio of grain yield to above ground biological yield on dry weight basis in percentage [13] as described in the following formula.

$$HI = \left(\frac{grain\ yield}{above\ ground\ biomass}\right) * 100$$

Data analysis

The collected data was analyzed using analysis of variance (ANOVA) appropriate to randomized complete block design using statistical analysis system version 9.3 software [14] and the interpretations were made following the procedure described by [15] Least Significant Difference (LSD) test at 5% probability level was used for treatment mean comparison when the ANOVA showed significant differences among treatments.

Economic analysis

The open market price for sorghum (6.42 Birr kg^{-1}) and the cost incurred for P and K fertilizers (TSP =18.5 Birr kg^{-1}), potassium chloride (KCl = 12.2 Birr kg^{-1}) and the labor cost incurred for fertilizer transportation and application (Labor cost= 100 Eth birr day^{-1}) was used. Grain yield was adjusted to 10% downward due to management difference to reflect the difference between the experimental yield and the yield that farmers could expect from the same treatment [16]. The dominance analysis procedure was done to select potentially profitable treatments (Table 1). Dominance analysis was also done to the selection of treatments ranked in increasing order of total variable costs. The Marginal Rate of Return (MRR (%)) was calculated by dividing the change in net benefit to the change in variable costs. 100% MRR means for every one Birr invested in different cost of fertilizer and maize seed, farmers can expect to recover one Birr and obtain an additional one birr [16].

Results and Discussion

Soil characteristics	Value	Rating	References
Soil pH (1:2.5)	5.07	Strongly acidic	[17]
Av. P (mg kg-1)	2.496	Low	[18]
TN (%)	0.167	Medium	[19]
OC (%)	2.644	Medium	[19]
OM (%)	4.558	Medium	[19]
CEC (cmol(+) Kg-1)	16.06	Medium	[20]
Sand (%) Silt (%) Clay (%)	60 5 35	Soil Textural Class: Sandy clay loam which is ideal	[21]

Table 1: Selected soil physico-chemical properties of the experimental sites before planting.

Grain Yield

The ANOVA result showed that grain yield of sorghum was significantly influenced due to various phosphorus levels. The highest grain yield (4517.0 kgha^{-1}) was obtained from plots treated with (46 - 40 kg ha^{-1}) PK while the lowest grain yield (2212.6 kgha^{-1}) was obtained from zero level of phosphorus. The result revealed that yield increase as increasing levels of phosphorus in a certain level but the highest value was recorded in plots receiving additional combination of K fertilizer. This result might be due to the contribution of K which ultimately increased the final grain yield. Potassium (K) is an essential nutrient for crop production and fulfills several important roles in plant growth next to N and P. It helps plants in their physiological processes such as transportation of water, nutrients and carbohydrates, photosynthesis, N utilization, stimulation of early growth, insect and disease resistance for plants [22,23] also reported state that K is important for strengthening plant stalks and therefore helps to resist fungal and bacterial attacks as well as the lodge. Moreover, the maximum yield recorded with PK fertilization is most likely an indicator due to their deficiency in the in the study area especially P. Plants showed normal growth with the application of phosphorus and resulted in improved agronomic traits which lead toward improved grain yield as reported [24]. The maximum yield obtained from PK treated plots might be also due to their synergistic effect, the efficiency of these elements is enhanced resulting in increased crop productivity. So, maximum accumulation of PK nutrients gave highest yield. The current result is in conformity with the finding of [25] who reported that grain yield at maximum accumulation of nutrient occurs when nutrient rate is increased.

Biomass Yield

The ANOVA result revealed that biomass yield increased consistently with increasing phosphorus rates from 0 to 46 kg ha^{-1}. Plots treated with (46-40 kgha$^{-1)}$ PK produced maximum biological yield (7134.3 kg ha^{-1}that produced 24.78% yield advantages compared with zero level of phosphorus. The maximum biomass yield recorded from PK fertilization might be due to the contribution of K nutrient in supporting the physiological functions of plants through promoting leaf expansion via regulating the uptake of nitrates from soil, balancing phosphorus uptake, photosynthesis, and dry matter accumulation. While in control plots (absence of phosphorus fertilization) minimum biological yield (5366.4 kg ha^{-1}) was recorded. The lower biomass yields recorded from the control plot revealed that neither sole application nor lower rates of P is sufficient to boost sorghum production significantly and to maintain soil fertility status at optimum level. The current result is in conformity with the finding of [5] who reported that balancing mineral nutrients (N, P and K) increases grain yield and biomass weight of sorghum significantly.

In general, incorporating K fertilizer up to certain value increased grain and biomass yield because K is a primary plant and animal nutrient that plays a major role in ensuring maximum growth and economic yields from agricultural farms. Optimum nutrition of P is critical for root development, increased stalk and stem strength, increased flowering and seed production, uniform and early crop maturity, improved crop quality, and increased resistance to plant diseases thereby all over grain yield and biomass weight of sorghum. [26] also supported that combined use of N and K significantly increased most growth parameters of sorghum which enhances high biomass production.

Harvest Index (HI)

The physiological efficiency or translocation of assimilates from source into economic sinks is known as Harvest Index (HI). The value of harvest index showed significant effect due to different levels of phosphorus fertilizer. In the present experiment, with increasing the rate of phosphorus fertilizer up to 46 kgha^{-1} harvest index increased significantly. At site -1 the maximum harvest index value (48.0%) was observed from plots treated with 57.5 kg ha^{-1} P, while at site 2 the maximum harvest index (47.8%) was observed from combined fertilization of PK at rate of (46-40) kgha^{-1}. This indicates that significantly lower biomass partitioning to grain production when P was increased beyond certain level. The lower mean HI values in this experiment with the higher P application might indicate the need for the enhancement of biomass partitioning through genetic improvement (Table 2).

Treatments (P rate kgha-1)	Grain yield (kgha-1)	Biological yield (kgha-1)	Harvest Index (%)
T1 = Control	2212.6f	5366.4c	41.2bcd
T2 = 11.5	2663.2e	6465.7ab	40.0d
T3 = 23.0	3148.6d	6425.2ab	41.8cd
T4 = 34.5	3334.5d	6238.0b	45.4abc
T5 = 46.0	3575.5cd	6334.8b	46.5ab
T6 = 57.5	3965.2bc	6475.1ab	48.0a
T7 = 69.0	4091.8ab	6527.9ab	47.2ab
T8 = 46-40 (P-K)	4517.0a	7134.3a	46.21abc
Mean	3438.54	6370.93	44.79
LSD (0.05)	434.29		4.50
CV (%)	7.21	6.87	5.73

Table 2: Effect of Phosphorus fertilizer level on grain yield, biomass yield and HI of sorghum.

Economics of Fertilizer Use

From the treatments used, PK nutrients increased the financial returns relative to that achieved without them which gained net benefit of 23, 273.23ETBha^{-1} with MRR 520.18% at site -1 and at site -2 net benefit of 18,645.63ETBha^{-1} with MRR 211.97% as shown (Table 3). This recommendation was in conformity with the manual of [15] which reported that farmers should be willing to change from one

treatment to another if the marginal rate of return of that change is greater than the minimum acceptable rate of return. The current result is also parallel with the finding of [27] who shares the same opinion after analyzing the financial data of fertilizer use in cotton. Therefore, the present study revealed that combined use of PK under constant value of N fertilizer is better in economic terms for maximum sorghum production [28-32].

Treatments (P rate (kg ha-1))	GY (Kg ha-1)	Adj.GY (Kg ha-1)	GFB (ETB ha-1)	TVC (ETB ha-1)	NB (Birr ha-1)	MRR (%)
T1 = 0	2212.6	1991.34	12784.40	0	12784.4	-
T2 = 11.5	2663.2	2396.88	15387.97	462.5	14925.47	462.93
T3 = 23.0	3148.6	2833.74	18192.61	925.0	17267.61	506.41
T4 = 34.5	3334.5	3001.05	19266.74	1387.5	17879.24	132.24
T5 = 46.0	3575.5	3217.95	20659.24	1850.0	18809.24	201.08
T6 = 57.5	3965.2	3568.68	22910.93	2312.5	20598.43	386.85
T7 = 69.0	4091.8	3682.62	23642.42	2775.0	20867.42	58.16
T8 = 46-40 P-K	4517.0	4065.3	26099.23	2826.0	23273.23	520.18

Table 3: Partial budget analysis for fertilizer use in sorghum production.

Conclusion

Based on the results obtained, we can conclude that as increasing rate of phosphorus fertilization increased the productivity of sorghum in constantly. Application of phosphorus and potassium fertilizer at a rate of 46-40 kg ha^{-1} has been found agronomical optimum for increasing the yield and yield components of sorghum. The result further revealed that the existing blanket recommendation of 46kg N ha^{-1} and 40kg K ha^{-1} has been found sub-optimal in response to the ever-increasing soil fertility depletion of the study area.

Nutrients with high harvest index values remove more of that nutrient from the field than nutrients with low harvest index values and suggest a looming soil fertility crisis if adequate adjustments are not made in usage of balanced nutrients increases productivity.

Data Availability

The data used to support the results of this study are included within the manuscript, and any further information is available from the corresponding author upon request.

Conflict of Interest

The authors declared that there is no conflict of interest.

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References

1. Azrag AAD, Dagash YMI (2015) Effect of sowing date and Nitrogen rate on growth, yield components of Sorghum Sorghum Bicolor L and Nitrogen Use Efficiency. Journal of Progressive Research in Biology.
2. Akram A, Fatima M, Ali S, Jilani G, Asghar R (2007) Growth, yield and nutrients uptake of sorghum in response to integrated phosphorus and potassium management. Pakistan Journal of Botany 39: 1083-1087.
3. Taye T (2013) Sorghum production technologies training manual. Ethiopian Agricultural Research Organization EARO Melkassa Research Center Nazret, Ethiopia 5-45.
4. Geremew G, Asfaw A, Taye T, Tesfaye T, Ketema B, et al.(2004) Development of sorghum varieties and hybrids for dry land areas of Ethiopia. Uganda Journal of Agricultural Science 9: 594-605.
5. CSA Central Statistical Authority Agricultural Sample Survey (2015) Central Statistical Agency Report on area and production of crops. Statistical Bulletin 589. Addis Ababa.
6. CSA (Central Statistical Authority, Agricultural Sample Survey) (2017) Report on the area and major production for major crops of Private peasant holdings. Addis Ababa Ethiopia.
7. Gebremeskel G, Egziabher YG, Solomon H (2017) Response of sorghum Sorghum bicolor L Moench varieties to blended fertilizer on yield yield component and nutritional content under irrigation in Raya valley Northern Ethiopia. International Journal of Agriculture and Biosciences 6: 153-162.
8. Tesfaye B, Rurinda J, Kebede M, Mutegi J, Hailu G, et al. (2019) Yield response and nutrient use efficiencies under different fertilizer applications in maize Zea mays L in contrasting agro ecosystems. International Journal of Plant and Soil Science 29: 1-9.
9. Sato A, Oyanagi A, Wad M (1996) Effect of phosphorus content on the emergence of tillers in wheat cultivars. Journal of Japan Agricultural Research center 1: 27-30.
10. Khalid M, Ijaz A, Muhammad A (2003) Effect of nitrogen and phosphorus on the fodder yield and quality of two Sorghum cultivars (Sorghum bicolor L.). International Journal of Agricultural Biology 5: 61-63.
11. Wispelaere L, Marcelino V, Alemayehu R, De Grave E, Dumon M, et al. (2015) Revisiting nitic horizon properties of Nitisols of Southwestern Ethiopia. Geoderma 243: 69-79.
12. Adugna A, Tefera T, Deresa A (2005) Sorghum production guideline: Production and research experience. EARO 1-31.
13. Donald CM (1962) In search of yield. Journal of Australian Institute of Agriculture Science 28: 171-178.
14. SAS (Statistical Analysis System) Institute. (2011).SAS/AF® 9.3: Procedure guide, 2nd edition: Cary, NC: USA.
15. Gomez KA, Gomez AA (1984) Statistical procedures for agricultural research.
16. CIMMYT International Maize and Wheat Improvement Center (1988) *from* agronomic data to farmer recommendations: An economics training manual.
17. Batjes NH (1995) A global data set of soil pH properties. Technical Paper 27, International Soil Reference and Information Centre (ISRIC), Wageningen.
18. Tekalign M, Haque I (1991) Phosphorus status of some Ethiopian soils, II. Forms and distribution of inorganic phosphates and their relation to available phosphorus. Tropical Agriculture 68: 2-8.
19. Birhanu D (1980) A survey of studies conducted about soil resources appraisal and evaluation for rural development in Ethiopia, Addis Ababa 70.
20. Hazelton P, Murphy B (2007) Interpreting soil test results: What do all the numbers mean? 2nd edition. CSIRO Publishing 152.

21. Onwueme IC, Sinha TD (1991) Field crop production in tropical Africa. Technical Centre for Agricultural and Rural Cooperation.

22. Marschner P, Rengel Z (2012) Nutrient availability in soils. In Marschner's mineral nutrition of higher plants. Academic Press 315-330.

23. Kenyanya O, Wachira JM, Mbuvi H (2013) Determination of potassium levels in intensive subsistence agricultural soils in Nyamira, Kenya. International Journal of Agriculture and Forestry 3: 294-302.

24. Iqbal Z, ALatif S, Ali MM, Iqbal (2003) Effect of fertigated phosphorus on P use efficiency and yield of wheat and maize. Songklanakarin. Journal of Scientific Technology 25: 697-702.

25. Assefa A (2008) Indigenous soil nutrient supply and effects of fertilizer application on yield, N, P and K uptake, and recovery and use efficiency of barley in three soils of Teghane, the Northern Highlands of Ethiopia. African Journal of Agricultural Research 3: 688-699.

26. Pholsen S, Sormsungnoen N (2005) Effects of Nitrogen and Potassium Rates and Planting Distances on Growth, Yield and Fodder Quality of a Forage Sorghum (Sorghum bicolor L. Moench). Pakistan Journal of Biological Sciences 7: 1793-1800.

27. Khaliq A, Abbasi MK, Hussain T (2006) Effects of integrated use of organic and inorganic nutrient sources with effective microorganisms on seed cotton yield in Pakistan. Biological resource Technology 97: 967-972.

28. Alam SM, Shah SA (2002) Phosphorus uptake and yield of wheat as influenced by integrated use of phosphatic fertilizers. Pakistan Journal of Agricultural science 39: 4.

29. Bayu W, Rethman NFG, Hammes PS, Alemu G (2006) Effect of farmyard manure and inorganic fertilizers on sorghum growth, yield and nitrogen use in a semi-arid area of Ethiopia. Journal of plant nutrition 29: 391-407.

30. Fageria VD (2001) Nutrient interactions in crop plants. Journal of plant nutrition 24: 1269-1290.

31. Masebo N, Menamo M (2016) The effect of application of different rate of NP Fertilizers rate on yield and yield components of sorghum (Sorghum Bicolor L.): In Case of Derashe Woreda, Southern Nations Nationality People Region, Ethiopia. Journal of Natural Sciences Research 6: 88-94.

32. Mesfin K, Zemach S (2015) Effect of Nitrogen and Phosphorus Fertilizer Rates on Yield and Yield Components of Barley (Hordeum Vugarae L.) Varieties at Damot Gale District, Wolaita Zone, Ethiopia. American Journal of Agriculture and Forestry 3: 271-275.

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