



Effect of Compost and Phosphorus Application On Growth, Yield and P-Uptake of Durum Wheat (*Triticum durum* Desf.) On Vertisol, Central Highland of Ethiopia

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Abstract – Durum wheat is among the most important crops produced in the central highlands of Ethiopia. However, declining soil fertility as well as poor soil fertility management practices have been resulting in low yields of the crop. Therefore, a field experiment was conducted to investigate the effect of compost and phosphorus application on growth, yield and P-uptake of durum wheat in vertisol of Debrezeit Agricultural Research Centre during the 2011 main cropping season. An experiment with a factorial combination of six levels of phosphorus (0, 46, 69, 92, 115 and 138 kg P₂O₅/ha) and three levels of compost (0, 10 and 20 tonnes/ha) were laid out in a Randomized Complete Block Design with three replications. The sources of N and P were Urea and Triple Super Phosphate, respectively. A durum wheat variety known as Ude was used for the study. The main effect due to compost rates highly significantly influenced most of the agronomic parameters and significantly affected days to physiological maturity and grain protein content. Moreover, the interaction effect of phosphorus and compost highly significantly affected tiller number, spike length, harvest index and grain protein content and significantly influenced plant height, number of grains per spike, grain yield, straw yield and biomass yield. However, the main effect of phosphorus had no significant influence on all parameters studied except days to physiological maturity. Application of compost at the rate of 20 tonnes/ha resulted in the highest number of fertile spike (273.9/m²), thousand kernel weight (37.89gm) and grain protein content (10.36%). Similarly, the highest plant height (73cm), spike length (4.917cm), number of tillers plant⁻¹ (3.767), number of grains per spike (41.69), grain yield (2922 kg/ha), straw yield (4290 kg/ha), biomass yield (7212 kg/ha) and harvest index (40.52%) were obtained from combined application of 20 tonnes/ha compost and 138 kg P₂O₅/ha. The grain and straw P concentrations as well as uptake of the nutrient increased with increased application of compost and phosphorus. Most of the agronomic parameters had positive and significant linear associations among each other. The overall result of the experiment revealed that application of phosphorus alone did not affect most of the parameters studied. However, sole application of compost as well as combined application of phosphorus with compost resulted in the production of maximum yield and yield components of wheat. It could, thus, be concluded that applying compost in combination with mineral phosphorus fertilizer resulted in a synergistic effect that led to markedly enhanced production of biomass as well as grain yield of the crop.

Keywords – Compost, Durum Wheat, Phosphorus Uptake and Phosphorus Concentration, P₂O₅- Di- Phosphorus Penta Oxide, Ha= Hectar

I. INTRODUCTION

Durum wheat is among the most important crops produced in the central highlands of Ethiopia. The average productivity of wheat in Ethiopia is 1.84 ton/ha, which is lower than the average world productivity (2.5 ton/ha) [1]. However low fertilizer usages especially P led to low durum wheat production in Ethiopia [2].

Durum wheat is mostly grown on heavy black clay soils (vertisols) of the central and northern highlands of Ethiopia [3]. About 95% of fertilizers used in vertisol areas are applied to tef and wheat. Next to nitrogen, phosphorus is the second most widely occurring nutrient deficiency in vertisols.

P Use Efficiency of various crops is low because of high fixation capacity of the soil. The various reactions of applied P in the soil become less available to plants are one of the factors attributing to low P recovery [4]. Hence, organic matter plays a great role to reduce phosphorus fixation in the soil and to enhance the efficiency of P fertilizer application.

When the nutrient permanently fixed then, organic materials are applied, the overall fertility status of the soil is built up and the total reserve of nutrients is increased [5]. Compost is more than chemical fertilizer to build phosphorus status of the soil. Application of only compost at the higher level or combined with chemical fertilizer, the available phosphorus concentration became very high. The presence of CaCO₃ in calcareous soils affected the availability of phosphorus. After applying an organic source of nutrition, the bond of phosphorus compounds with CaCO₃ is broken [6].

P fertilizer application did not improve wheat and tef production on vertisols of Ada'a plain [7]. All the previous studies totally depend on yield data without understanding the residual effect of P fertilizer applied. Therefore, studies are required to understand why P application alone did not improve wheat yield on vertisols at Debrezeit. Hence, this study was initiated with the objective of investigating the effect of compost and phosphorus application on growth, yield and P-uptake of durum wheat in vertisol.

II. METHODOLOGY

2.1 Description of the Study Area

The study was conducted in the experimental field of Debrezeit Agricultural Research Centre during the 2011 m-

-ain cropping season.

2.2 Treatments, Experimental Design and Procedures

The treatments consisted of six rates of P fertilizer (0, 46, 69, 92, 115 and 138 kg P₂O₅/ha) and three levels of compost (0, 10, 20 tonnes/ha). The experiment was laid out in a randomized complete block design (RCBD) and replicated three times. The plots and blocks were separated by 0.5 m and 1 m space, respectively. The plot size was 3.6 m x 2.2 m (7.92 m²) with 0.2 m row spacing and each plot accommodated 11 rows. Two outer rows and a 0.5 m row length on both ends were not harvested for data collection. Hence, the net plot size to collect data was 2.6 m x 1.8 m = 4.68 m². The sieved compost was incorporated into the soil five days before sowing. *Ude wheat variety*, sown using 150 kg ha⁻¹. P fertilizer was applied at planting time. N fertilizer was applied two times at planting time and at mid-tillering stage. All weeds were removed.

2.3 Data Collection

Days to seedling emergence, Days to 50% heading and Days to physiological maturity

Number of grains per spike, spike length, plant height, number of tillers per plant, grain yield, straw yield, biomass yield, thousand kernel weight and harvest index was also determined. Hectolitre weight was estimated using a standard hectolitre apparatus and weighed by an electronic balance then converted using standard hectolitre manual. Grain protein content was determined by:

$$\% \text{ protein} = \% N \times 5.75 \quad (1)$$

Where, 5.75 is wheat factor

2.4 Components of Phosphorus Use Efficiency

$$P \text{ Uptake Efficiency (\%)} = \left(\frac{Pt_f - Ptc}{P_s} \right) \times 100 \quad (2)$$

$$P \text{ Use Efficiency for grain yield (kg TDM kg}^{-1}P) = \frac{GDWf - GDWc}{P_s} \quad (3)$$

2.5 Data Analysis

The data were subjected to analysis of variance using GnStat software. Significant treatment differences were separated using the Least Significant Difference test at 5% level of significance.

III. RESULTS AND DISCUSSION

Available P was high (20.53 mg/kg). After harvesting, compost increased the available P from 20.53 to 21.95 mg/kg P. Application of compost or combined with P increases the P-uptake.

3.1 Days to Seedling Emergence

Compost and phosphorus as well as their interaction had no significant effect.

3.2 Days to Heading

Different rates of compost and phosphorus significantly affected days to 50% heading. Their interaction did not have significant effect. Increasing the level of compost from 0 to 20 ton/ha delayed days to 50% heading. Application of phosphorus greatly hastened days to

heading. These results agreed with [8]. P played a great role on seed formation [9].

3.3 Days to Physiological Maturity

The applied rates of P and compost differed significantly but no effect on interaction. Hence, compost releases different nutrients till to end plants received compost were green. The shortest number of days recorded at the highest rate of phosphorus. The same result with [10].

Table I. Days to 50% seedling emergence and heading; days to 90% physiological maturity as affected by compost and phosphorus fertilizer

Treatments	Days to 50% seedling emergence	Days to 50% heading	Days to 90% physiological maturity
Compost(ton/ha)			
0	7.500	65.39 ^b	105.0 ^b
10	7.500	65.78 ^{ab}	105.78 ^{ab}
20	7.167	67.89 ^a	106.61 ^a
LSD (5%)	Ns	0.903	0.838
Phosphorus (kgP ₂ O ₅ /ha)			
0	7.111	69.00 ^a	107.11 ^a
46	7.222	66.56 ^{ab}	106.11 ^{ab}
69	7.333	66.89 ^{ab}	106.22 ^{ab}
92	7.444	65.78 ^{ab}	106.0 ^{ab}
115	7.556	65.00 ^{ab}	105.22 ^b
138	7.677	64.89 ^b	105.11 ^b
LSD (5%)	Ns	1.278	1.186
CV (%)	7.8	4.1	1.2

3.4 Effect of Compost and Phosphorus on Growth Parameters, Yield and Yield Component

3.4.1 Plant height

The main effect of compost affected plant height highly significantly (P < 0.01). Compost and phosphorus interacted significantly (P < 0.05) to influence plant height. However; the main effect of phosphorus did not influence.

Table II. Interaction effect of compost and phosphorus on plant height and tiller number

Compost (tonnes/ha)	Phosphorus (kg P ₂ O ₅)	Plant Height (cm)	No. of Tiller
0	0	60.83 ^j	3.500 ^{fg}
	46	65.17 ^{ghi}	3.467 ^g
	69	61.67 ^{ij}	3.567 ^{def}
	92	66.33 ^{fgh}	3.567 ^{def}
	115	66.67 ^{efg}	3.533 ^{efg}
	138	62.33 ^{hij}	3.567 ^{def}
10	0	67.67 ^{c-g}	3.600 ^{cde}
	46	66.5 ^{fg}	3.600 ^{cde}
	69	71 ^{a-d}	3.633 ^{cd}
	92	68 ^{b-g}	3.533 ^{efg}
	115	67.33 ^{d-g}	3.567 ^{def}
	138	65.33 ^{ghi}	3.633 ^{cd}
20	0	68.67 ^{b-g}	3.667 ^{bc}
	46	71.67 ^{abc}	3.733 ^{ab}
	69	70 ^{a-f}	3.600 ^{cde}
	92	70.67 ^{a-e}	3.733 ^{ab}
	115	71.83 ^{ab}	3.733 ^{ab}
	138	73 ^a	3.767 ^{ab}
LSD (5%)		4.033	0.091
CV (%)		3.6	1.5

Means with in a column followed by the same letter are not statistically different at 5% level of significance.

Plant height did not show significant difference with phosphorus application. This might be due to presence of high level of available P in the soil [11].

The tallest plants were recorded at the highest level of compost combined with P₂O₅. The shortest plants were obtained without application of both fertilizers. Hence, compost played roles by increasing plant height compared to phosphate. Similar result with [12].

3.4.2 Tiller Number

The main effect of compost and its interaction with P had highly significant (P < 0.01) effect on the number of tillers per plant. However, the main effect of phosphorus was not significant.

The maximum number of tillers (3.767) was recorded at the highest rate of compost combined with P₂O₅. Similarly, [13] reported the same result. The non-significant effect due to P might be the presence of high level of available P in the soil.

3.4.3 Spike Length, Grains per Spike and Thousand Kernel Weight

The main effect of compost and the interaction highly significantly affected. P fertilizer alone had no significant effect. The longest spike was obtained at the highest level of both fertilizers.

Table III. Interaction of compost and phosphorus on spike length and number of grains per spike

Compost (tonnes/ha)	Phosphorus (kg P ₂ O ₅ /ha)	Spike length (cm)	Number of grains per spike
0	0	4.683 ^c	37.10 ^e
	46	4.742 ^{b-c}	37.27 ^{de}
	69	4.742 ^{b-c}	37.44 ^{cde}
	92	4.767 ^{bcd}	37.64 ^{b-e}
	115	4.750 ^{b-c}	37.79 ^{b-e}
	138	4.733 ^{cde}	37.30 ^{de}
10	0	4.792 ^{bc}	39.43 ^{bc}
	46	4.767 ^{bcd}	39.03 ^{b-e}
	69	4.767 ^{bcd}	39.68 ^{ab}
	92	4.767 ^{bcd}	39.33 ^{bcd}
	115	4.775 ^{bcd}	38.18 ^{b-e}
	138	4.700 ^{de}	37.13 ^e
20	0	4.792 ^{bc}	38.00 ^{b-e}
	46	4.758 ^{b-e}	39.58 ^{ab}
	69	4.775 ^{bcd}	39.28 ^{bcd}
	92	4.750 ^{b-c}	39.00 ^{b-e}
	115	4.817 ^b	39.75 ^{ab}
	138	4.917 ^a	41.69 ^a
LSD (5%)		0.078	2.121
CV (%)		1	3.3

Compost and its interaction with P had highly significant on number of grains per spike. However, P had no significant effect. Similar result was reported by [14]. More number of grains/spike obtained at highest level of both fertilizers. The lowest number of grains per spike was noted in the control. Similar result reported by [15].

Table IV. Effect of compost on thousand kernel weight of wheat

Compost (ton/ha)	Thousand Kernel Weight (g)
0	36.33 ^b
10	37.28 ^a
20	37.89 ^a
LSD (5%) 0.804	

Compost highly significantly (P < 0.01) affected thousand kernel weight. The main effect of phosphorus as well as its interaction with compost did not affect. [16] and [17] reported that sole application of compost increased 1000 seed of wheat. This increased availability of plant nutrients, improvement of soil water holding capacity [18].

3.4.4 Grain Yield

The main effect of compost highly significantly (P < 0.01) affected but the main effect of phosphorus did not significantly affect. However, significant effect observed on interaction.

The highest grain yield obtained with application of compost and phosphorus. The lowest grain yield was recorded at zero levels of both fertilizer. [19] and [20] also reported that combining both fertilizer resulted higher yields. Adding organic substances increases soil microbial activities which improved crop yield [21].

3.4.5 Straw Yield

Highly significant (P < 0.01) and significant effects (P < 0.05) observed due to the main effect of compost as well as the interaction effect. However, phosphorus did not influence significantly.

The highest straw yield were recorded in response to the combined application of 10 ton compost per hectare with 69 kg P₂O₅ ha⁻¹ and 20 tonnes compost per hectare combined with 46 and 138 kg P₂O₅/ha. The lowest straw yields were recorded at control level (Table IV). The same result obtained by [22]. Straw yield of wheat increased with increase in application of a mineral fertilizer and also with increase in compost rates [23].

3.4.6 Biomass Yield

Highly significant differences (P < 0.01) in biomass yield were observed due to the main effect of compost and significant differences (P < 0.05) were observed due to the interaction effect of compost with phosphorus (P < 0.05). However, no significant difference due to P rates [24]. The highest biomass yield was obtained with combined application of 20 tonnes/ha with 46 kg P₂O₅/ha. Similar result obtained by [25].

Table IV. Interaction effect of compost and P on grain, straw and biomass yield of wheat

Compost rate (tonnes ha ⁻¹)	Phosphorus (kgP ₂ O ₅ /ha)	Grain yield (kg/ha)	Straw yield (kg/ha)	Biomass yield (kg/ha)
0	0	2485 ^e	3947 ^f	6432 ^f
	46	2512 ^{de}	3999 ^{ef}	6511 ^{ef}
	69	2520 ^{de}	3977 ^d	6497 ^{ef}
	92	2578 ^{cde}	4014 ^{c-f}	6592 ^{def}
	115	2650 ^{bcd}	4037 ^{c-f}	6687 ^{c-f}
	138	2607 ^{b-e}	3984 ^{def}	6592 ^{def}
10	0	2660 ^{bcd}	4101 ^{b-f}	6761 ^{b-e}
	46	2646 ^{bcd}	3978 ^{def}	6624 ^{def}
	69	2745 ^b	4253 ^{ab}	6998 ^{ab}
	92	2693 ^{bc}	4138 ^{a-e}	6832 ^{bcd}
	115	2601 ^{b-e}	4061 ^{c-f}	6661 ^{c-e}
	138	2608 ^{b-e}	4154 ^{a-d}	6762 ^{b-e}
20	0	2608 ^{b-e}	4052 ^{c-f}	6659 ^{c-f}
	46	2707 ^{bc}	4248 ^{ab}	6955 ^{abc}
	69	2649 ^{bcd}	4027 ^{c-f}	6675 ^{c-f}
	92	2705 ^{bc}	4139 ^{a-e}	6844 ^{bcd}
	115	2756 ^b	4188 ^{abc}	6944 ^{abc}
	138	2922 ^a	4290 ^a	7212 ^a
LSD (5%)		157.9	176.7	305.6
CV (%)		3.6	2.6	2.7

3.4.7 Harvest index

Table V. Harvest index of wheat as affected by compost and P interaction

phosphorus (kg P ₂ O ₅ /ha)	Compost (tonnes/ha)			
	0	10	20	Mean
0	38.63 ^f	39.54 ^{b-e}	39.16 ^{c-f}	39.11
46	38.58 ^f	39.94 ^{ab}	38.92 ^{def}	39.15
69	38.79 ^{ef}	39.23 ^{b-f}	39.68 ^{bc}	39.24
92	39.11 ^{c-f}	39.41 ^{b-e}	39.50 ^{b-e}	39.34
115	39.63 ^{bcd}	39.04 ^{c-f}	39.68 ^{bc}	39.45
138	39.55 ^{bcd}	38.56 ^f	40.52 ^a	39.54
Means	39.05	39.29	39.58	
LSD (5%) = 0.75 ; CV (%) = 1.2				

Harvest index was highly significantly ($P < 0.01$) influenced by the main effect of compost as well as the interaction effect of compost and phosphorus. However, this parameter was not significantly influenced by phosphorus application.

3.5 Effect of Compost and Phosphorus on Grain

Protein Content and Hectolitre Weight

Significant ($P < 0.05$) and highly significant ($P < 0.01$) variations were observed due to compost and interaction effect respectively. There was no significant difference on phosphate levels. The highest protein contents of wheat obtained at the combined application of 10 ton per hectare with 138 kg P₂O₅ ha⁻¹ and when 20 ton per hectare combined with 115 kg P₂O₅/ha. [26] reported composts with inorganic fertilizers increased protein content than alone.

Table VI. Grain protein content (%) of wheat as influenced by the interaction effect

Phosphorus (kg P ₂ O ₅ /ha)	Compost (tonnes/ha)		
	0	10	20
0	9.51 ^e	10.24 ^{bcd}	10.28 ^{bcd}
46	10.2 ^{bcd}	10.23 ^{bcd}	9.89 ^{de}
69	10.43 ^{a-d}	9.93 ^{cde}	10.45 ^{abc}
92	10.28 ^{bcd}	10.08 ^{bcd}	10.45 ^{abc}
115	10.06 ^{bcd}	10.16 ^{bcd}	10.94 ^a
138	9.89 ^{de}	10.52 ^{ab}	10.14 ^{bcd}
LSD (5%) = 0.5551 ; CV (%) = 3.3			

Hectolitre weight did not vary significantly due to the compost, phosphorus and their interactions. [27] reported that N is required by microorganisms for composting and it affects hectolitre weight; low N concentration in compost content of the soil gave non significant effect of compost.

3.6 P concentration in Plant Tissue

P concentration in the grain and straw tissues affected highly significantly ($P < 0.05$) affected due to interaction effect. Phosphorus did not affect.

Table VII. Concentration of grain and straw P of wheat as influenced by interaction effect

P ₂ O ₅ (kg/ha)	Grain P (%)				Straw P (%)			
	Compost (ton ha ⁻¹)			Means	Compost (ton/ha)			Means
	0	10	20		0	10	20	
0	0.3851 ⁱ	0.4109 ^{b-f}	0.4087 ^{c-g}	0.4016	0.0743 ^f	0.0956 ^{b-d}	0.0886 ^{dc}	0.0862
46	0.3992 ^{f-i}	0.4072 ^{c-g}	0.417 ^{a-e}	0.4078	0.0775 ^{ef}	0.0908 ^{c-e}	0.1061 ^{ab}	0.0915
69	0.3941 ^{g-i}	0.4208 ^{a-c}	0.4088 ^{c-g}	0.4079	0.0787 ^{ef}	0.1033 ^{a-c}	0.0943 ^{b-d}	0.0921
92	0.3913 ^{hi}	0.4047 ^{d-h}	0.4248 ^{ab}	0.4069	0.0881 ^{de}	0.0979 ^{b-d}	0.0965 ^{b-d}	0.0942
115	0.4029 ^{e-h}	0.4018 ^{e-h}	0.4199 ^{a-d}	0.4082	0.0926 ^{b-d}	0.0865 ^{d-f}	0.1057 ^{ab}	0.0949
138	0.399 ^{f-i}	0.405 ^{d-h}	0.4284 ^a	0.4108	0.0883 ^{de}	0.0864 ^{d-f}	0.1123 ^a	0.0957
Means	0.3953	0.4084	0.4179		0.0833	0.0934	0.1006	
LSD (5%) 0.015; CV(%) 2.3					LSD (5%) 0.013; CV(%) 8.8			

The P concentrations increased might be attributed to the synergy between compost and the P fertilizers in promoting uptake of the nutrient. Application of organic fertilizer with mineral fertilizer increased P concentration

[28]. The main effect of compost and interaction of compost with P fertilizers had highly significant ($P < 0.01$) effect on grain and straw P uptake. The effect of P fertilizer was not significant.

Table VIII1. Grain and straw P uptake of wheat as affected by interaction effect of compost and P

Phosphorus (kg P ₂ O ₅ /ha)	Grain P Uptake (kg P/ ha)			Straw P Uptake (kg P/ ha)		
	Compost (ton/ ha)			Compost (ton/ ha)		
	0	10	20	0	10	20
0	9.57 ^f	10.94 ^{b-d}	10.49 ^{c-f}	2.93 ^f	3.92 ^{b-d}	3.59 ^{de}
46	10.03 ^{d-f}	10.78 ^{b-e}	11.29 ^{bc}	3.09 ^{ef}	3.61 ^{de}	4.51 ^{ab}
69	9.93 ^{ef}	11.56 ^b	10.83 ^{b-e}	3.13 ^{ef}	4.4 ^{a-c}	3.8 ^{cd}
92	10.09 ^{d-f}	10.91 ^{b-d}	11.49 ^b	3.54 ^{de}	4.06 ^{b-d}	4 ^{b-d}
115	10.68 ^{b-e}	10.45 ^{c-f}	11.59 ^{ab}	3.74 ^d	3.51 ^{d-f}	4.44 ^{ab}
138	10.41 ^{c-f}	10.43 ^{c-f}	12.52 ^a	3.52 ^{d-f}	3.58 ^{de}	4.82 ^a
LSD (5%) = 0.96; CV (%) = 5.3			LSD (5%) = 0.59; CV(%) = 9.5			

The highest P uptake in the grain and straw was recorded by combining high levels of both fertilizers might be attributed to higher yield of grain and straw and P concentration of in both. organic fertilizer improves soil structure and nutrient uptake. Compost prevents the losses of chemical fertilizers through denitrification and leaching by binding to nutrients [29]. Uptake of N, P and K increased in plants when organic sources of nutrients applied in the form of chemical fertilizer [30]. From the maximum total P uptake at highest compost and P rate found from the grain yield. Thus, it was the grain yield that assimilated much of the nutrients applied.

3.7 P Uptake and P Use Efficiency for Grain Yie

P uptake efficiency showed highly significant effects

due to compost, phosphorus and their interaction. With the increase in P fertilizer rates, the uptake of P efficiency decreased [31] showed that nutrient use efficiency is high at a low yield level. Organic materials enhance nutrient use efficiency by slowly releasing of nutrients [32].

[33] and [34] reported that recovery of inorganic fertilizers by plants was less than 10%. These might be due to significant losses of nutrients by leaching, runoff, and fixation by soil. Combined application of compost at 20 tonnes/ha and 46 kg P₂O₅ / ha led to the highest P uptake efficiency. Organic fertilizers prevent the loss of chemical fertilizers through volatilization and leaching by binding to nutrients. Thus, integrated use of chemical fertilizers and recycled organic wastes enhances efficiency of chemical fertilizers [35].

Table IX. Interaction effect of compost and phosphorus on P uptake efficiency and P use efficiency for grain yield of wheat

Phosphorus (kg P ₂ O ₅ /ha)	P uptake efficiency (%)				P Use efficiency for grain yield (kg grain kg P ⁻¹)			
	Compost (tonnes/ ha)				Compost (tonnes/ ha)			
	0	10	20	Means	0	10	20	Means
46	3.04	9.35	16.27	9.55	1.30	7.94	10.95	6.73
69	1.84	11.37	7.01	6.74	1.16	8.57	5.39	5.04
92	2.78	6.08	7.39	5.42	2.30	5.15	5.42	4.29
115	3.81	2.88	6.96	4.55	3.26	2.18	5.36	3.63
138	2.35	2.48	7.97	4.27	2.01	1.47	7.19	3.56
Means	2.76	6.43	9.12		2.01	5.08	6.86	
LSD (5%) = 3.807				LSD (5%) = 4.361				

The main effect of compost and interaction of compost with P levels had highly significant (P < 0.01) on P uses efficiency for grain yield. P fertilizer had no significant effect. The highest value was recorded at 20 tonnes ha⁻¹ and 46 kg P₂O₅/ha. The decrease in P use efficiency for grain yield with increasing P rate is due to enhanced P fixing power of the soil in proportion to the amount of inorganic fertilizer applied to the soil. [36] obtained that agronomic efficiency decreased consistently with increasing the level of P in rice.

IV. CONCLUSION AND RECOMMENDATIONS

The present study was conducted to investigate the effect of compost and phosphorus application on growth, yield and P-uptake of durum wheat at Debrezeit

Agricultural Research Centre. The experiment consists three levels of compost (0, 10 and 20 tonnes/ha) and six levels of phosphorus (0, 46, 69, 92, 115 and 138 kg P₂O₅/ha) in Randomized Complete Block Design with three replications.

All parameters were significantly affected by compost rates except days to seedling emergence and hectolitre weight of grain. However, the main effect of phosphorus had no significant influence on all parameters except days to physiological maturity. Application of compost at the rate of 20 tonnes/ ha resulted in more no of thousand kernel weight (37.89gm) and grain protein content (10.36%). The highest plant height (73cm), spike length (4.917cm), number of tillers plant⁻¹ (3.767), number of grains per spike (41.69), grain yield (2922 kg/ ha), straw yield (4290 kg/ha), biomass yield (7212 kg/ ha) and harvest index (40.52%) were obtained from maximum

levels of both fertilizers. The grain and straw P concentrations as well as uptake of the nutrient increased with increased application of compost and phosphorus. It could, thus, be concluded that applying compost in combination with mineral phosphorus fertilizer resulted in a synergistic effect that enhance production of biomass and grain yield of the crop. Hence, further field trials replicated over locations and seasons should be conducted in the study area using a number of durum wheat varieties with the use of integrated organic as well as mineral NP fertilizers.

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