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EFFECT OF SOIL MULCHING, SOIL PHOSPHORUS FERTILIZER AND HUMIC ACID ON BROAD BEAN YIELD.

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Abstract

A field experiment was carried out through winter season of 2019 in the field of Agriculture College, Wasit University to study the effect of soil mulching with wheat residues (control and with mulch), three levels of phosphorus (control, 120 and 240 Kg ha^{-1} P) and four concentration of humic acid (control, 1000, 2000 and 3000 Mg L^{-1}) on seed yield of broad bean. Split- split-plot arrangement within a randomized complete block design (RCBD) with three replications was used. The broad bean seeds variety Semillas Fito was planted at a spacing of 25 cm × 50 cm on 5 October 2019. The results showed that soil mulching, adding phosphorous and humic acid spraying caused significant effects on plant pods number, seed and biological yield compared to control treatment. Soil mulching and adding phosphorous caused a significant increase in 100-seed weight. Highest seed weight achieved from mulching soil and 148-280 kg ha^{-1} P_2O_5 adding as well as humic acid spraying.

Key words: Mulching, phosphorus, humic acid, broad bean.

Introduction

The Broad bean crop (*Vicia faba* L.) is one of the main leguminous crops that have a high protein content, making it the most consumed in its season due to its multiple uses, whether as green pods, green seeds or dry seeds. It is also rich in carbohydrates and protein as well as containing quantities of good vitamins and nutrients (Ofuya and Akhidue, 2005). The productive capacity of crops is subject to service operations followed according to modern scientific foundations, including soil mulching with crop residues to improve the environment of the plant, maintain the soil moisture, regulate its temperature, reducing the salinity and increase the proportion of organic matter in it, as well as reduce competition from weeds (Chalker-Scott, 2007). Franczuk *et al*., (2016) indicated that the mulching affected the broad bean seed yield compared with the control treatment.

The good growth of the crop is related to the readiness of important nutrients to increase production, especially phosphorous, as one of the major important nutrients. Phosphorous had superior ability to increase the speed of root growth, especially root hairs, the proportion of its mass and depth in the soil (Mokhtar, 2001). Adak and Kibritci, (2016) reported that phosphate fertilizer at levels of 40 and 80 kg ha^{-1} increased broad bean yield and its components. Humic acid, as organic fertilizers improve the plant's nutritional status and speed up growth and increase yield (El-Habbasha *et al.,* 2012). Fouda, (2017) found that humic acid spraying significantly increased plant pods number, pod weight, soft and dry weight of Broad bean yield. Noor *et al.,* (2018) showed that humic acid spraying caused an increase in plant pods number, 100 seeds weight and seed yield. Considering the above importance, a field experiment has been carried out to study the effect of the soil mulching, spraying of phosphorus and humic acid on the yield broad bean and its component.

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Materials and Methods

The research was conducted in the field of the Agriculture College, Wasit University during the winter season of 2019 in sandy loam soil (Table 1) to study the effect of soil mulching with wheat residues (control and mulching), three levels of phosphorus (control, 120 and 240 kg ha^{-1} P_2O_5) and four concentration of humic acid (control, 1000, 2000 and 3000 mg L^{-1}). Split-split-plot arrangement within a randomized complete block design (RCBD) with three replications was used. The experimental unit was 6 m^2 containing 4 planting lines 50 cm apart and 3 m long. The broad bean seeds of Semillas Fito variety were sown on 5 October 2019 in hills 25 cm apart. The phosphate fertilizer was added at one time at planting inline 10 cm from the seed line, while the nitrogen fertilizer (40 Kg ha^{-1}) was added after the 40 days from planting. At physiological maturity on 10 April in 2020, the data were calculated from the inner lines of each experimental unit. The data were analyzed and the means were compared using the least significant difference (LSD) test at probability levels of 0.05.

Results

Table 2 showed that soil mulching, phosphorus, humic acid and interactions caused a significant effect on plant pods number. Soil mulching achieved higher plant pods no. to 11.66 pods compared to control treatment that gave 9.60 pods. This result was agreed with Alsaadawi *et al.,* (2013) and Franczuk *et al.,* (2016). High phosphorus levels (240 kg ha^{-1}) gave the highest plant pods no. of 11.06 pods, while control treatment gave the lowest (9.80 pods). This result was in line with Jasim *et al.,* (2016) and Fouda, (2017). Whereas humic acid (2 g L^{-1}) gave the highest plant pods number of 11.04 pods compared to control which gave the lowest number (10.09 pods). This result was in line with Shafeek *et al.,* (2013) and Sayed *et al.,* (2014). The interactions caused a significant effect.

Table 3 showed that soil mulching and phosphorus caused a significant effect on 100 seeds weight of broad bean crop, while humic acid and the interactions had no significant effect. The highest 100 seeds weight (110.0 g) obtained from mulching treatment compared to low weight (104.46 g) obtained from the control treatment. This result was in line with Hameed and Shahwany, (2015). The phosphorus levels of 240 kg ha^{-1} gave the maximum weight of (109.21 g) compared to control treatment that gave the minimum weight of 105.4 g. This result was in agreement with El-Gizawy, (2009).

Seed yield affected significantly by soil mulching, phosphorus, humic acid and interactions (Table 4). Maximum seed yield (4.877 t ha^{-1}) was observed at soil mulching, while minimum seed yield (3.707 t ha^{-1}) was obtained from the control treatment. This result was

Table 1: Some chemical and physical properties of soil field experiment (depth 0-30 cm) for the season 2019.

Value and unit	Character		Value and unit	Character
559 gm kg^{-1}	Sand	Soil components	7.3	pH
365 gm kg^{-1}	Silt		3.45 dS m^{-1}	(EC)
76 gm kg^{-1}	Clay		28.1 mg kg^{-1}	Available N
Sandy loam	Soil texture		7.29 mg kg^{-1}	Available P
0.61 %	Organic matter		33.0 mg kg^{-1}	Available K
			1.29 gm cm^{-3}	Bulk density

Table 2: Effect of soil mulching, phosphorus, humic acid and interactions on the No. of pod per plant of broad bean during the season 2019.

Mulching	P (kg ha^{-1})	Humic acid mg.L^{-1} 0	1000	2000	3000	Mulching × P
mulching	P 0	11.70	11.52	11.61	8.50	10.84
	P 1	10.04	13.16	13.25	12.01	12.11
	P 2	13.60	11.56	10.32	12.67	12.04
control	P 0	9.20	9.19	8.33	8.37	8.77
	P 1	10.20	10.15	10.05	9.30	9.93
	P 2	10.73	11.04	10.65	10.09	10.09
Humic mean		9.64	10.67	10.36	9.69	
LSD $_{0.05}$		Humic=0.670		Interaction=1.960		n.s
Interaction of humic × mulch						Mulch mean
mulch		11.66	11.78	12.08	11.73	11.06
control		9.60	9.68	10.00	9.58	9.12
LSD $_{0.05}$		n.s				1.984
P 0 (control)		9.80	10.45	10.36	9.97	8.44
120 kg ha^{-1}		11.02	10.12	11.66	11.65	10.66
1240 kg ha^{-1}		11.06	11.62	11.11	10.34	11.18
LSD $_{0.05}$		1.273				0.886

Table 3: Effect of soil mulching, phosphorus, humic acid and interactions on 100 seeds weight of broad bean during the season 2019.

Mulching	P (kg ha^{-1})	Humic acid mg.L^{-1} 0	1000	2000	3000	Mulching × P
mulching	P 0	102.67	105.70	107.77	109.00	106.28
	P 1	108.40	107.23	109.57	113.80	109.75
	P 2	114.30	111.20	117.87	112.53	113.98
control	P 0	101.70	103.43	106.23	106.70	104.52
	P 1	103.83	103.97	106.03	103.80	104.41
	P 2	102.36	107.83	102.20	105.40	104.45
Humic mean		105.54	106.56	108.28	108.54	
LSD $_{0.05}$		Humic=n.s.		Interaction=n.s		3.943
Interaction of humic × mulch						Mulch mean
mulch		108.46	108.04	111.73	111.78	110.00
control		102.63	105.08	104.82	104.46	104.46
LSD $_{0.05}$		interaction=n.s				4.215
Interaction of p × humic						Mulch mean
P 0 (control)		102.18	104.57	107.00	107.85	105.40
120 kg ha^{-1}		106.12	105.60	107.80	108.80	107.08
1240 kg ha^{-1}		108.33	109.52	110.03	108.97	109.21
LSD $_{0.05}$		interaction=n.s				2.897

Table 4: Effect of soil mulching, phosphorus, humic acid and interactions on seeds yield of the broad bean during the season 2019.

Mulching	P (kg ha^{-1})	Humic acid mg.L^{-1} 0	1000	2000	3000	Mulching × P
mulching	P 0	3.241	4.669	4.553	4.828	4.323
	P 1	4.940	5.392	5.572	5.137	5.260
	P 2	5.333	4.183	5.064	5.616	5.049
control	P 0	3.020	3.364	3.540	3.416	3.335
	P 1	3.777	3.827	3.860	3.843	3.827
	P 2	3.520	4.688	4.026	3.608	3.960
Humic mean		3.972	4.354	4.436	4.408	
LSD $_{0.05}$		Humic=0.3169		Interaction=0.9315		n.s
Interaction of humic × mulch						Mulch mean
mulch		4.504	4.748	5.063	5.194	4.877
control		3.439	3.960	3.809	3.622	3.707
LSD $_{0.05}$		interaction=n.s				0.9182
Interaction of p × humic						Mulch mean
P 0 (control)		3.130	4.017	4.446	4.122	3.829
120 kg ha^{-1}		4.358	4.609	4.716	4.490	4.544
1240 kg ha^{-1}		4.426	4.436	4.545	4.612	4.505
LSD $_{0.05}$		interaction=n.s				0.4425

in line with Alsaadawi *et al.,* (2017). Adding phosphorus level of (120 kg ha^{-1}) gave the highest seed yield of (4.544 t ha^{-1}), while the lowest was (3.829 t ha^{-1}) obtained from control (without adding phosphorus). This result is consistent with Munir and Abdel-Rahman (2002). Humic acid spraying at 2000 Mg.L^{-1} gave maximum seed yield (4.436 t ha^{-1}) compared to control treatment that gave the lowest yield of 3.972t ha^{-1}. This result was in line with Canellas and Olivares, (2014) and Saif El-Deen, (2011). The interaction between the factors caused significant effect and maximum yield obtained from soil mulching with 240 kg ha^{-1} phosphorus and 3000 mg l^{-1} humic acid, while minimum yield obtained from the control treatment.

Table 5 showed that soil mulching, phosphorus and humic acid caused a significant effect on the biological yield of broad bean crops, while the interactions had no significant effect. The soil mulch achieved the highest biological yield of (11.758 t. ha^{-1}) compare to control treatment (without mulching) that gave the lowest biological yield of 9.970 t. ha^{-1}. This result was agreed with Franczuk *et al*., (2016). Phosphorus adding at 240 kg ha^{-1} gave the highest biological yield (11.491 t ha^{-1}), compared to control treatment (without phosphorus) which gave the lowest value (10.081 t ha^{-1}). This result was in line with (Christensen and Drabble, 2009). Humic acid spraying at 3000 Mg.L^{-1} gave the maximum biological yield (11.099 t ha^{-1}), while control treatment gave the minimum biological yield of 10.453 t ha^{-1}. This result was agreed with Cesco *et al*., 2000).

Table 5: Effect of soil mulching, phosphorus, humic acid and interactions on the biological yield of the broad bean during the season 2019.

Mulching	P (kg ha^{-1})	Humic acid mg.L^{-1} 0	1000	2000	3000	Mulching × P
mulching	P 0	9.590	10.672	11.070	11.500	10.708
	P 1	11.570	11.943	12.350	12.533	12.099
	P 2	12.420	12.047	12.430	12.973	12.468
control	P 0	9.293	9.610	9.544	9.370	9.454
	P 1	9.837	9.917	10.077	9.934	9.941
	P 2	10.010	11.457	10.304	10.283	10.514
Humic mean		10.453	10.941	10.963	11.099	
LSD $_{0.05}$		Humic=0.4764		Interaction=n.s		n.s
Interaction of humic × mulch						Mulch mean
mulch		11.193	11.554	11.950	12.336	11.758
control		9.713	10.328	9.975	9.863	9.970
LSD $_{0.05}$		interaction=n.s				1.3200
Interaction of p × humic						Mulch mean
P 0 (control)		9.442	10.141	10.307	10.435	10.081
120 kg ha^{-1}		10.703	10.930	11.213	11.234	11.020
1240 kg ha^{-1}		11.215	11.752	11.367	11.628	11.991
LSD $_{0.05}$		interaction=n.s				0.6820

Discussion

Results revealed that adding soil mulching, phosphorus, humic acid caused a significant increase in plant pods number, 100 seeds weight and total yield compared to control treatment. There were significant differences in seed yield by mulches (wheat residues) compared to control treatment. Mulches are either protect soil against the unfavorable effect of atmospheric factors during a period or while the main crop is grown (Kołota and Adamczewska-Sowinska, 2004), as well as to sustain stable soil fertility accompanied by enhanced productivity and a good quality yield. Mulches improve soil physical properties, prevent erosion, regulate temperature and water retention, as well as increase the biological activity (Stanford, 1982).

Availability of phosphate ions causes plant's resistance to lodging, early product maturity, higher quality, increasing plant growth from emergence to the beginning of flowering, pollination and consequently, the crop yield will increase (Hosseinzadeh, 2005). Humic acid is rich in both organic and mineral substances which are essential to plant growth and consequently increasing yield quality and quantity. Many investigators (El-Bassiony *et al*., 2010; Vijayakumari *et al*., 2012 and Shafeek *et al*., 2013) illustrated that high rates of humic acid on broad bean recorded the high values of total yield and its components (seed weight, pod number and weight and total yield).

Conclusions

Based on the results of the present study, it can be concluded that: The seed yield and biological yield were significantly and positively affected by soil mulching, phosphorus and humic acid treatments. The highest seed and biological yield were obtained when mulching, adding phosphorus at 240 kg ha^{-1} and humic acid spraying at 3000 mg L^{-1} respectively. soil mulching, adding of phosphorus and humic acid spraying caused an enhance in plant growth and increase broad bean yield and its component, further study may be needed to perform in different environmental conditions.

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