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Full Length Research Paper

Determination of the critical level of phosphorus in rapeseed dry land agriculture in the southeastern of Khuzestan

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In order to determine the critical level of phosphorus using the kate – Nelson method, economic outlook and the Mitcherlich equation in the rape dry farming of canola in Behbahan region, 16 experiments in four regions and each region in 4 experiments in four groups of soil, using phosphorus (less than 3 mg/kg, 3 to 6 mg/kg, 6 to 10 mg/kg and more, 10 mg/kg) in the form of randomized complete blocks design with four phosphate fertilizer treatments (0, 25, 50, 75 kg/h P_2O_5) from triple super phosphate source in four replications for two agricultural years (2008 to 2010) was implemented. In the experiment of Hyola 401 was used. The results showed that the critical level of soil phosphorus to Kate - Nelson, economic outlook and the equation Mitcherlich is respectively 7, 6, 9.4 mg/kg.

Key words: Kate-Nelsonl method, canola, the critical level, balanced fertilization.

INTRODUCTION

Rapeseed (*Brassica napusl)* is an oil plant that plays an important role in human nutrition from oil extract. It also has an important role in providing feed for livestock and poultry (Roody et al., 2004; Abdolrahmi, 2004). This plant has more than 40% oil and protein in the seed meal (Ahmadi and Javidfar, 1998; Deshiri, 1999). Proper use, timely and balanced nutrients is one way of achieving higher grain yield, oil content and quality of rapeseed seeds (Ahmadi and Javidfar, 1998; Morshedi et al., 2001). Phosphorus is an essential element required for rapeseed. Phosphorus intake increased oil and protein percentages in this plant. Phosphorus fertilizer can cause prematurity of rapeseed and are generally positive effects on performance and product quality (Ahmadi and Javidfar, 1998; Alizadeh, 2000; Melekoti, 2001). Therefore, to achieve optimal performance, improve product quality and prevent environmental pollution and ultimately achieve sustainable agricultural use of phosphorus fertilizers is necessary. In Iran, consumption of phosphate fertilizers for many years unbalanced and was excessive use for plants and the soil is often problematic. Environmental pollution through the accumulation of cadmium in soil and disturbance in the absorption of zinc, iron and magnesium for plants are such problems (Shahabi, 1998; Gaibi, 2000; Melekoti, 2001). Considering that the majority of land under wheat cultivation in Behbahan are dedicated to the cultivation of rapeseed, and the use of phosphate fertilizers in wheat lands, there are the possibility of unbalanced and excessive accumulation of phosphorus fertilizers on the land. It also recommended the formulation of fertilizer recommendations based on the land for the cultivation of rapeseed in the Agricultural Research Centre (recommended provincial) is 60 kg/h of pure nitrogen, 45 kg/h P_2O_5 and 50 kg/h K_2O (Abdolrahmi, 2004; Alizadeh, 2000). So for all soil fertility of the available phosphorus

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(low, medium, high and very high) are offered the same fertilizer formula. The fertilizer formulation has many problems such as excessive use of phosphate fertilizers, nutrient imbalance, environmental pollution and eventually to soil fertility decline in some groups there. The fertilizer formulation has many problems such as excessive use of phosphate fertilizers, nutrient imbalance, environmental pollution and reduce performance in some soil fertility groups. So to achieve a balanced and efficient use of phosphorus fertilizers in the cultivation of rapeseed in the area, determination of the critical level and recommended fertilizer is essential. Tests to determine the amount of fertilizer at the farm is most reliable way the use of fertilizers. But this is not posible; therefore, suitable way is collection of data and generation of results. Data from soil analysis must be divided into two or more groups. When the element absorbed by plants in soil can be divided into two groups, the critical element is the border between the two groups (Gaibi, 2000; Melekoti, 2001). Critical level to determine whether or not the farm need fertilizer, but does not specify the amount of fertilizer (Melekoti and Homaei, 2004). Critical levels of soil nutrients is not constant and change with changing conditions. Affecting factors on critical levels of phosphorus soil are the amount of soil limestone, clay amounts, the amount of iron and aluminum oxides as well as management, performance and climate (Gaibi, 2000; Melekoti and Homaei, 2004; Shahabi, 1998).

Critical levels of phosphorus for rapeseed in some soils of Kansas 20 mg/kg have been reported (Manhattan, 1989). Critical levels of phosphorus for rapeseed in some soils of Canada 10 mg/kg have been reported (Melakoti and Gaibi, 2001). Critical levels of phosphorus for sesame, cotton and sunflower in the soil with organic less than 1% and uper 1% are 12 and 10 mg/kg, respectively. But this situation for soybean have been reported as 15 and 13 mg/kg respectively (Melakoti and Gaibi, 2001).

MATERIALS AND METHODS

This experiment was conducted in the city of Behbahan in the southeastern province in Iran. Four regions were selected and 64 composite surface soil samples from a depth of 0 to 30 cm contain at least 10 to 15 simple samples were collected. values of soil phosphorus in calcareous soils due to the Olsen (sodium bicarbonate) was measured.

These regions soils were calcareous. Therefore, the amount of soil phosphorus by Olsen method (sodium bicarbonate) was measured. Then, amount of soil phosphorus groups (low, medium, high and very high) were classified. Between them the parts needed for the experiment were randomly selected. In order to determine the critical level of phosphorus in the kit – Nelson method, economic outlook and the Mitcherlich equation rapeseed. Dry land agriculture in Behbahan region, 16 experiments in four regions and each region in four experiments in four groups of soil usable phosphorus (less than 3 mg/kg, 3 to 6 mg/kg, 6 to 10 mg/kg and more than 10 mg/kg) in the form of randomized complete block design with four phosphate fertilizer treatments (0, 25, 50, 75 kg/h P_2O_5) from triple super phosphate source in four replications for two agricultural years (2008 to 2010) was implemented. Distance between four regions was 35 to 50 km and intervals in each region were 3 to 5 km. Therefore, each test consisted of 16 plots. A plot have 5 m of length and 8 lines with 30 cm planting distance between the rows and 5 cm distance between plants. Planting date coincided with the first rain fall in the region. In this test, it was used in the 401 Hyola figure. The culture was serially and seed rate was 8 kg/h.

In all treatments consumption of pure nitrogen from urea was 60 kg/h and 50 K_2O kg/h source of potassium was used as the base. Removed from the surface (1.5 * 4 m or 6 m^2) from each plot was conducted and yield was determined with 10% humidity. Before planting, soil samples consisting of a surface of each piece and some physicochemical factors such as EC, pH, lime, the percentage of organic carbon, sand, silt, clay soil phosphorus and potassium were measured (Table 5). Mitcherlich equation coefficients (c, c1) were calculated. To calculate c1 using treatment performance, P_2O_5 CX was zero and C1 calculated. C for treatments P_2O_5, 25 and P_2O_5, 50 in all parts test was calculated. The relative performance of C in the first level of fertilizer treatments (P_2O_5, 25) was 90% and the second level of the fertilizer treatments (P_2O_5, 50) were calculated. Experiments that their relative performance in two levels of the fertilizer treatments was 90 and 95% respectively, and c value were calculated. Critical levels of phosphorus to the kit - Nelson and the economic outlook was calculated (Tables 1 to 4).

RESULTS AND DISCUSSION

Calculated using the critical level kit - Nelson

To access the relationship between relative performance and results of soil analysis (P values), the critical phosphorus using video kit - Nelson was determined. Critical phosphorus levels equivalent to 7 mg per kg was determined in Figure 1 and the Tables (Alizadeh, 2000; Deshiri, 1999).

The critical level is calculated using the equation of Mitcherlich – Barry

The C1 = 0.0222 = and C = 0.0183 was determined (Tables 3 and 4). After using equation of Mitcherlich - Barry phosphorus, critical levels for the relative performance (95%) was calculated:

$$\text{Log } (100 - 95) = \text{Log } 100 - 0.0222 \text{ b}$$

Critical levels of phosphorus using the aforementioned equation, 59 kg of P_2O_5 or 9.4 ppm of phosphorus per hectare was calculated.

Calculate the critical level of phosphorus from the perspective of the economic crisis

Using this method, the critical level of phosphorus was calculated as follows: control performance - the highest performance with the consumption of food(up treatment) = new function (kg per hectare). The critical level is 6 mg/kg

Table 1. Effect of different amount of phosphoric fertilizer on canola yield in the soils with different amount of absorbable phosphorus and determination.

Agricultural year 2008-2009	O_5 amounts used (kg in acre) P_2				Yield increase (kg/ha)	Absorbable phosphorus in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}					
	Yield (kg_s)								
Row	Y_0	Y_1	Y_2	Y_3			b	P_2O_5 25	P_2O_5 50
1	455/25	333/5	373	367/75	-17.4	6-Feb	-	-	-
2	337/25	499	396/5	464/25	127	8-Feb	0/0437	-	0/0165
3	524	461/5	442/25	428/75	-3.8	7-Feb	-	-	-
4	523	378	410/25	466	-57	3-Feb	-	0/0288	0/0184
5	415	265/75	259/75	421	6	Apr-73	-	0/0173	0/0086
6	481/5	480/75	393/25	574	92/5	4-Apr	0/0315	0/0318	0/0094
7	447/25	351/5	339/25	466/75	19/5	May-43	-	0/0241	0/0114
8	441/25	351/5	339/25	466/75	-25May	Apr-67	-	0/0241	0/0114
9	449/25	303/75	306/75	476/5	27/25	4-Aug	-	0/0177	0/0089
10	547/25	569/25	527/25	497	-2	Aug-64	-	-	-
11	709	553/25	526/75	511/75	-7.88	Jul-64	-	-	-
12	661/75	555/25	505/75	526/75	135	Aug-49	-	-	-
13	475/5	402/5	685	828/25	-4.69333	Dec-44	0/0047	0/0117	0/0154
14	528	443/5	758/5	694	166	28-Nov	0/0087	0/0117	-
15	596/5	457/75	851/25	734/5	138	8-Dec	0/0095	0/0168	-
16	653/5	486	724	692/75	39/25	Nov-49	-	0/0209	-

Table 2. Effect of different amount of phosphoric fertilizer on canola yield in the soils with different amount of absorbable phosphorus and determination of Mitcherlich equation coefficient.

Agricultural year 2009-2010	O_5 amounts used (kg in acre) P_2				Yield increase (kg/ha)	Absorbable phosphor in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}					
	Yield (kg_s)								
Row	Y_0	Y_1	Y_2	Y_3			b	P_2O_5 25	P_2O_5 50
1	604/5	467/5	546/8	537/8	-9.42857	6-Feb	-	0/8861	-
2	594/5	628	578	675/75	81/25	8-Feb	0/9208	-	0/8539
3	696/75	647/25	657/75	692	-0.05333	7-Feb	-	-	-
4	662	550/5	667/75	726/5	64/5	3-Feb	-	0/6198	1/097
5	619/5	545/5	519/25	522/5	-97	Apr-73	-	-	-
6	665/25	544/75	492/25	756/75	91/5	4-Apr	0/9208	0/5528	0/4560
7	523/75	455/5	511/75	623/75	100	May-43	0/7959	0/5686	0/7445
8	492/25	333/5	430/5	636/75	144/5	Apr-67	0/6383	0/3188	0/4949
9	594/5	615/75	524/5	417/75	-2.34667	4-Aug	-	-	-

Table 2. Contd.

10	661/5	850/25	541/75	494/75	-2.21333	Aug-64	-	-	-
11	798	730	652/75	502/25	-3.93333	Jul-64	-	-	-
12	762/25	627/75	606/75	538/25	-224	Aug-49	-	-	-
13	530/25	518/5	896/5	735/5	205/25	Dec-44	0/5528	0/5229	-
14	545/75	500	912/5	847/25	301/5	28-Nov	0/4437	0/3872	-
15	639/75	575	1050/25	856/25	216/5	8-Dec	0/6021	0/4815	-
16	795	624/25	916/5	829/50	34/5	Nov-49	-	0/6021	-

Table 3. Effect of different amount of phosphoric fertilizer on canola relative yield in the soils with different amount of absorbable phosphor and determination of Mitcherlich equation coefficient.

Agricultural year 2008-2009	O_5 amounts used (kg in acre) P_2				Yield increase (kg/ha)	Absorbable phosphor in soil (ppm	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}					
	Relative yield								
Row	Y_0	Y_1	Y_2	Y_3			b	P_2O_5 25	P_2O_5 50
1	124	91	101	100	-17.4	6-Feb	-	-	-
2	73	107	85	100	127	8-Feb	0/0437	-	0/0165
3	122	108	103	100	-3.8	7-Feb	-	-	-
4	112	81	88	100	-57	3-Feb	-	0/0288	0/0184
5	99	63	62	100	6	Apr-73	-	0/0173	0/0086
6	84	84	66	100	92/5	4-Apr	0/0315	0/0318	0/0094
7	96	75	73	100	19/5	May-43	-	0/0241	0/0114
8	95	75	73	100	25/5	Apr-67	-	0/0241	0/0089
9	94	64	64	100	27/25	4-Aug	-	0/0177	
10	110	115	106	100	-2	Aug-64	-	-	-
11	139	108	103	100	-7.88	Jul-64	-	-	-
12	126	105	96	100	-135	Aug-49	-	-	-
13	57	49	83	100	-4.69333	Dec-44	0/0047	0/0117	0/0154
14	76	64	109	100	166	28-Nov	0/0087	0/0117	-
15	81	62	116	100	138	8-Dec	0/0095	0/0168	-
16	94	70	105	100	39/25	Nov-49	-	0/0209	-

(Figure 2) and Tables 1 and 2. Critical levels of phosphorus to the video kit - Nelson 7 and 6 mg/kg is the economic outlook. The equation based on performance relative to phosphorus Mitcherlich critical level of 95%, 9.4 mg/kg was calculated. Values of C and C1, of mitcherlich

Table 4. Effect of different amount of phosphoric fertilizer on canola relative yield in the soils with different amount of absorbable phosphorus and determination of Mitcherlich equation coefficient.

Agricultural year 2009-2010	O_5 amounts used (kg in acre) P_2				Yield increase (kg/ha)	Absorbable phosphor in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}					
	Relative yield (%)								
Row	Y_0	Y_1	Y_2	Y_3			b	P_2O_5 25	P_2O_5 50
1	112	87	102	100	-9.42857	6-Feb	-	0/0356	-
2	88	93	86	100	81/25	8-Feb	0/0780	-	0/0171
3	101	94	95	100	-0.05333	7-Feb	-	-	-
4	91	76	92	100	64/5	3-Feb	-	0/0248	1/0219
5	119	104	99	100	-97	Apr-73	-	-	-
6	88	72	65	100	91/5	4-Apr	0/0365	0/0221	0/0019
7	84	73	82	100	100	May-43	0/0234	0/0227	0/0149
8	77	52	68	100	144/5	Apr-67	0/0219	0/0128	0/599
9	142	147	126	100	-2.34667	4-Aug	-	-	-
10	134	117	109	100	-2.21333	Aug-64	-	-	-
11	159	145	130	100	-3.93333	Jul-64	-	-	-
12	142	117	113	100	-224	Aug-49	-	-	-
13	72	70	122	100	205/25	Dec-44	0/0071	0/0209	-
14	64	59	108	100	301/5	28-Nov	0/0062	0/0155	-
15	75	67	123	100	216/5	8-Dec	0/0080	0/0193	-
16	96	75	110	100	34/5	Nov-49	-	0/0241	-

Table 5. Some of the physical and chemical specifications in agricultural soil under test.

Silt (%)	Clay (%)	Sand (%)	PH	EC (m/ds)	Active lime (%)	Organic carbon (%)	Absorbable potassium (ppm)	Absorbable phosphorus (ppm)	Farms within groups	Fertilizing soil group compare to phosphorus available in soil (ppm)
36	23	41	9-Jul	8-Feb	40	0/5	112	6-Feb	1	Less than 3
32	26	42	5-Jul	Feb-89	40	0/65	121	3-Feb	2	
30	27	43	8-Jul	3-Feb	43	0/75	118	8-Feb	3	
30	25	45	2-Aug	Feb-76	38	0/4	115	5-Feb	4	
30	29	41	Jul-52	4-Mar	40	0/75	160	4-Apr	1	3-6
22	34	46	Jul-51	5-Feb	42	0/52	158	5	2	
20	28	52	8-Jul	8-Feb	39	0/61	169	5-Apr	3	
28	30	48	Jul-61	2-Mar	44	0/68	143	2-Apr	4	

Table 5. Contd.

30	29	41	7-Jul	3-Mar	42	0/62	180	4-Aug	1	6-10
30	31	39	6-Jul	5-Mar	45	0/72	196	21-Aug	2	
28	32	40	5-Jul	8-Feb	40	0/77	203	5-Jul	3	
28	30	42	8-Jul	5-Mar	46	0/65	206	3-Aug	4	
32	26	48	1-Aug	6-Feb	47	11-Jan	238	Dec-44	1	More than 10
34	25	41	6-Jul	5-Mar	46/4	15-Jan	235	14/4	2	
30	28	42	4-Jul	4-Mar	42	1	320	16/5	3	
28	32	40	9-Jul	6-Feb	45/2	0/9	316	5-Dec	4	

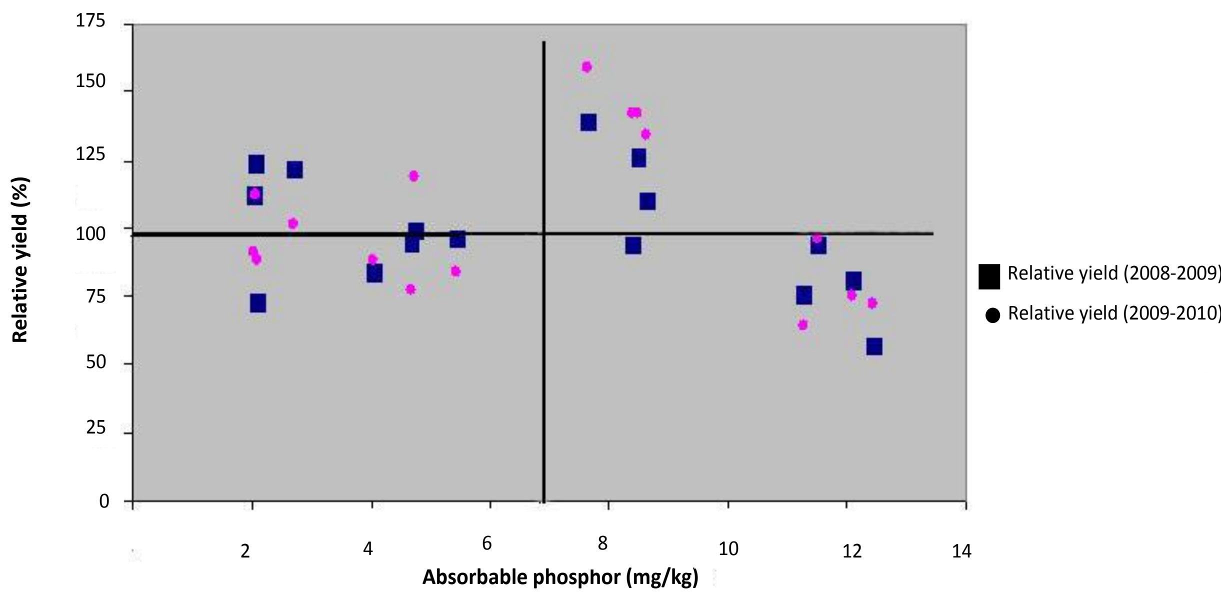

Figure 1. Determination of critical level of phosphorus according to kit-nelson picturuos method in canola dry farming agriculture.

equation was respectively 0.0183 and 0.0222. As affecting factors on critical levels of phosphorus, soil are the amount of soil limestone, clay amounts, the amount of iron and aluminum oxides as well as management, performance and climate therefore for calculation of critical levels of phosphorus; soil in dry lands of rapeseed should be considered as aforementioned; as the physical and chemical soil analysis results show the

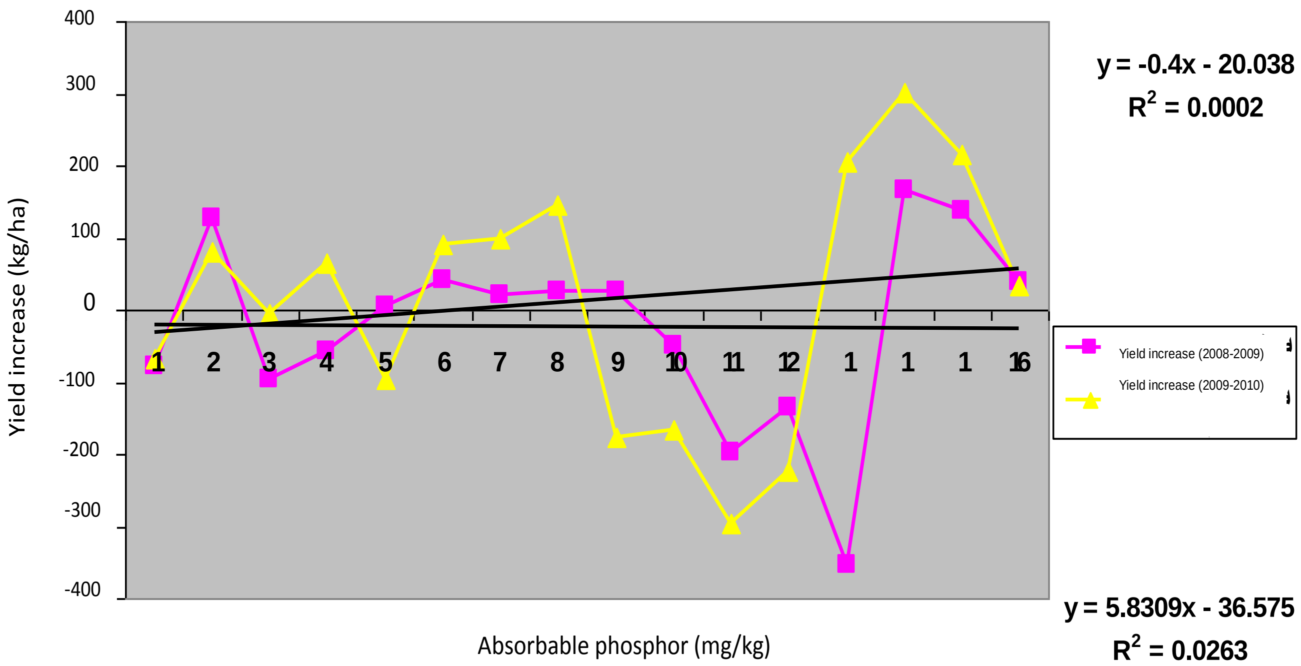

Figure 2. Determination of critical level of phosphorus from economical point of view in canola dry farming.

amount of lime on soil is high and soil organic matter is low. Therefore, the phosphorus in these soils are stabilized. Also, raining level in the region is 250 mm and tempreture is high. Therefore, it can be refered that critical levels of phosphorus for rapeseed in the soil with organic less than 1% and uper 1% are 7 and 9 mg/kg, respectively. Critical level of phosphorus in some soils of Kansas 20 mg/kg was reported (Manhattan, 1989). And the critical level of phosphorus in some soils of Canada 10 mg/kg was reported.

Critical level of phosphorus for sesame; cotton and sunflower in the soil with organic less than 1%, 12 mg/kg and in the soil with organic more than 1%, 10 mg/kg were reported. The critical level of phosphorus in rapeseed in this study is same of the critical level of phosphorus in sesame, cotton and sunflower in other studies. Thus, the critical level of phosphorus in the plant type, soil characteristics, climate and management are different.

Conclusion

The results show that the critical level of phosphorus for Kate-Nelson, the economic outlook and Mitcherlich equation are respectively, 7, 6 and 9.4 mg/kg. Also, for determination of the critical level of phosphorus in each area must be considered the plant type, soil characteristics, climate and management. Thus, critical levels of phosphorus for dry lands rapeseed in the soil with organic less than 1% and uper 1% are recommended 7 and 9 mg/kg, respectively.

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