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Full Length Research Paper

Development of phosphorus fertilizer according to the soil test in the rape dry farming of canola (*Brassica naplusl*) in the south east of Khuzestan province

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For development of phosphorus fertilizer needed for canola "*Brassica naplusl*" Hayola 401 figure according to the soil test in the dry framing 16 tests in four places and in each place 4 tests in 4 groups of phosphorus useable in the soil (less than 3 ppm, 3-6 ppm, 6-10 ppm and more than 10 ppm) in the form of randomized complete blocks design with 4 phosphorus fertilizer treatments (0, 25, 50 and 75 kg of $P_2 O_5$ in each acre) triple super phosphate sources were used in 4 repetition for 2 agricultural years (2008 to 2010). The results obtained show that the fertility index degrees in phosphorous groups used in the soil have been determined as (less than 3 ppm, 3-5 ppm, 5-7 ppm and more than 7 ppm) respectively (60, 44, 25 and 0 kg $P_2 O_5$ in acres).

Key words: Canola (*Brassica napusl*), phosphorous fertilizer, soil test.

INTRODUCTION

Canola (*Brassica napusl*) is an oil plant and plays an important role in the human nutrition by its oil. It also plays an important role in the animals and birds nutrition (Abdolrahmi, 2004; Roody et al., 2004). Since this plant consists of more than 40% oil in its seeds and about 40% protein in oil cake, therefore it is very important (Ahmadi and Javidfar, 1998; Deshiri, 1999). Correct and on time use of nutrition is one of the important ways of getting the best seed's yield and the oil and better quality of canola seeds (Ahmadi and Javidfar, 1998; Morshedi et al., 2001). Phosphorus is one of the necessary elements for canola. Correct use of phosphorus increases percentage of oil and protein. Phosphorus fertilizers cause early development of canola and totally have positive effects on the products yield and quality (Ahmadi and Javidfar, 1998; Alizadeh, 2000; Melekoti, 2001). Therefore to reach the best and suitable yield and stopping environment pollution and finally use of stable agriculture with the use of optimal phosphorus fertilizer. Use of phosphorus fertilizer in Iran has been in unstable form for many years and it was used much more than necessary for agriculture and in many cases its excess use has caused problems for the soil and also environmental pollution has been occurred in the soil (earth) with the collection of cadmium in the soil and also interference in absorption of zinc, iron and magnesium for production of agricultural products (Gaibi, 2000; Melekoti, 2001; Shahabi, 1998). In Behbahan since most of the land under wheat cultivation is under the cultivation of canola, and considering the use of phosphorus fertilizer in the mentioned lands, there is a chance of uneven collection of phosphorus fertilizer. Also, the fertilizer formula suggested for the canola cultivation land in the area and according to the suggestion of the center for agricultural research (state recommendation) and in the form of pure nitrogen at 60 kgs in an acre, p_2 o_5 at the amount of 45 kgs in each acre and k_2o at the amount of 50 kgs in each acre (Gaibi, 2000; Dembinski et al., 1969). Therefore for all groups of soil fertilizer phosphorus can be used with the amount of less, medium or very much which same

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fertilizer formula is presented. This fertilizer formula causes some sort of problems such as use of excess fertilizer, non even use of nutrition, environmental pollution and finally reduction of land fertilization. Therefore to reach a moderate and optimized use of phosphorus fertilizer on the land for fertilization, cultivation of canola in the area has been limited and the fertilizer used with the previous suggestions.

The best and most trustable way of using fertilizer is through the tests for determination of the level of fertilizer used in each form as necessary, but since this work is impossible with referring to the facilities, therefore the best method for transferring information and obtaining the results in the level of the area is the use of soil test and its calibration. The numbers obtained from soil decomposition and without determination of relation with the plant reaction has no value or concept. Manhattan (1989) reported that suggestion of phosphoric fertilizer for production of 3 tons of canola in some parts of the Kansas state in the form of soil (earth) has less than 10 mg kg^{-1} phosphorus, 130 kg ha^{-1} (P_2 O_5) the soil (earth) between 10 to 20 ppm which absorbable in the amount of 30 to 100 in each acre (p_2 o_5) and soils with more than 20 ppm absorption does not need any use of fertilizer.

Dembinski et al. (1969) in Poland's soil reported different situation of phosphor. In the soil with less phosphorus, the phosphorus fertilizer used is more than 18 kgs in an acre and in the soil with medium phosphorus the N.B need of phosphorus fertilizer is not secured while the use of 40 to 60 kgs is up to satisfactory. They also mentioned that suggestion of phosphoric fertilizer for areas with special conditions should be according to local data. Ukrainetz et al. (1975) (in Canada) had suggested the use of phosphorus fertilizer with seeds and locating it next to the seeds since it causes reduction in the use of phosphorus fertilizer. On the one hand the result they obtained show that application of more than 30 kgs in an acre P_2 O_5 in canola plant have less reaction to the fertilizer. Reaction of the plant with the type of soil and moisture differs. They also showed that Canola cultivation in LOMI soils has a good reaction with 90 kgs in an acre of P_2 O_5 and phosphoric fertilizer increases seeding up to 50% in the soil with extractable phosphor with sodium bicarbonate of more than 10 ppm, the reaction of canola to phosphoric fertilizer is less (SOPER, 1971). In the soil in India it has been reported that even though the phosphoric fertilizer is the cause of reaction of the plant, but the data available in the ground of availability of needed phosphorus or the optimal yield are inconsistence. It also seems that in many soils with high phosphor, there is no need for phosphorus fertilizer or even may be reaction of the canola plant to the phosphorus fertilizer is little more than predicted because of the seasonal differences the amount of phosphorus in the soil is not always measurable. Sandhu and Singh (1960), Sharma (1968), Gupta and Das (1973) and Melekoti and Homaei (2004) said that since phosphorus in the soil is non stable, to expand phosphorus fertilizer in some of the specifications of soil, the amount of phosphorus used in the soil, condition and season in the area, type of the plant and expected yield and many other nutritious elements should be objective.

MATERIALS AND METHODS

This study has been conducted in Behbahan, in the east west of Khuzestan Province with the longitude of 50 and latitude of 30°, north and altitude of 320 ms from the sea level. Behbahan is a city with semi dry which is located in the hot steppe weather. Average of raining in the area is the temperature in the past ten years (2008 to 2009) is equal to 313.5 mm and 35 d.c. respectively. For suggestion of phosphorus fertilizer needed for canola (kolza) hayola no.401 has been suggested according to the 16 tests in 4 different areas. In each area 4 tests in 4 groups of phosphorus useable in the soil (less than 3 ppm between 3 to 6 ppm and between 6 to 10 ppm and more than 10 ppm) as randomized complete blocks design with for treatment phosphorus fertilizer (0, 25, 50, 75, P_2O_5 in acre) has been repeated 4 times in triple superphosphate, which means in each group soil fertilities according to the amount of phosphorus useable in the testing soil has been randomized complete block design in 4 phosphorus fertilizer treatment in 4 repetitions. The space between the 4 areas is between 35 to 50 kms and the space between farms in each area is 3 to 5 kms. Therefore each test consisting of 16 leek with the length of 5 m with 8 lines of cultivation and the space between the bushes of 30 cm and the bushes space on row of 5 cm. The space between leeks (- terraces) 1.5 m from each side and the repeated space is also 1.5 m. The date of cultivation is equal to the first day of fall's raining in the area. The method of cultivation in row and the amount of seeds used is 8 kgs in an acre. In all treatments of 60 kgs of acre pure nitrogen (½ base and ½ when stemming) from the urea source and 50 kgs in acre of K_2O from the potassium sulfate resource is used as the base. Harvesting after the saddlebags equal to (1.5*4 m or 6 square meters) from each terrace has been done and the seed reaction with 10% of moisture has been determined and has been calculated in acre. This test has been conducted for 2 cultivation year (2008 to 2010). Also before the cultivation a sample of composite soil-(earth) from the surface has been chosen and some of the physiochemical factors such as electrical conductor (EC) pH in percentage of active lime, percentage of organic carbon, percentage of sand, sylite, clay, phosphor and potassium of the soil was measured (Table 5).

RESULTS AND DISCUSSION

Calculation of $c.c_1$ in Mitcherlich- Bray equation: in mitscherlich-beri equation: $\log(A-Y)= \log A- C_1 b-cx$

Yield maximum (Y): true yield percentage (b): (amount phosphorus useable in the soil) (X): phosphorus absorption of the soil. The amount of C_1 for the test piece has been calculated and the average of C_1 in all teat pieces for 2 years of cultivation is equal to 0.0222. Also the amount of C for treatments 25, and 50, P_2 O_5 in all test pieces are calculated and have been averaged and its amount has been equal to 0.0183. Also in the calculation of relative yielding of C in the first level of

Table 1. Effect of different amount of phosphorus fertilizer on canola yield in the soils with differen amount of absor bable phosphorus and determination of Mitscherlich equation coefficient.

Agricultural year 2008-2009	P_2O_5 Amounts used (kg in acre)				Yield increase kg/ha	Absorbable phosphorus in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}				P_2O_5 25	P_2O_5 50
	Yield (kgs)								
Row	Y_0	Y_1	Y_2	Y_3			b		
1	455/25	333/5	373	367/75	-87/5	2/06	-	-	-
2	337/25	499	396/5	464/25	127	2/08	0/0437	-	0/0165
3	524	461/5	442/25	428/75	-95/25	2/7	-	-	-
4	523	378	410/25	466	-57	2/03	-	0/0288	0/0184
5	415	265/75	259/75	421	6	4/73	-	0/0173	0/0086
6	481/5	480/75	393/25	574	92/5	4/04	0/0315	0/0318	0/0094
7	447/25	351/5	339/25	466/75	19/5	5/43	-	0/0241	0/0114
8	441/25	351/5	339/25	466/75	5/25	4/67	-	0/0241	0/0114
9	449/25	303/75	306/75	476/5	27/25	8/4	-	0/0177	0/0089
10	547/25	569/25	527/25	497	-50/25	8/64	-	-	-
11	709	553/25	526/75	511/75	-197/25	7/64	-	-	-
12	661/75	555/25	505/75	526/75	135	8/49	-	-	-
13	475/5	402/5	685	828/25	-352/75	12/44	0/0047	0/0117	0/0154
14	528	443/5	758/5	694	166	11/28	0/0087	0/0117	-
15	596/5	457/75	851/25	734/5	138	12/08	0/0095	0/0168	-
16	653/5	486	724	692/75	39/25	11/49	-	0/0209	-

fertilizer treatment P_2O_5 25 upto 90% and in the second level P_2O_5, 50 is up to 95% (Tables 1 to 4).

Determination of sufficiency percentage

Sufficiency percentage is calculated with the use of equation Log(A-Y)=LoyA-0.0222b and the calibration of the curve for determination of different degrees of phosphoric fertility has been known (Figure 1) and (Table 4). Grouping according to the phosphorus adsorption of the soil has been determined for the degree of fertility when phosphorus used in the soil is less than 3 ppm, 3-5 ppm, 5-7 ppm and more than 7 ppm for little, average much and too much.

Recommendation of fertilizer according to Mitcherlich-Beri equation for reaching suggested function

After calculation of c,c_1 (Mitcherlich-Beri equation coefficient, the equation will be shown as follows:

Log (A-Y) =log A -0/0222b-0/0183X

The amount of fertilizer needed for different amount of phosphor absorbable by soil and ratio functionality mentioned is calculated and produced (Table 6).

Fertilizer suggestion according to soil test in the dry farming of canola

According to the results obtained in Tables 6 and 7 and calibration curve (Figure 1) fertilizer suggestion according to soil test for different groups of phosphorus usable in soil (less than 3 ppm, 3 to 5 ppm, 5 to 7 ppm, and more than 7 ppm are determined as 60, 44, 25 and 0 kgs of P_2O_5 in each acre respectively.

According to the soil test the area fertility condition can be determined before the cultivation of the crop. And possibility of extra toxicity of the element in the soil will be determined. On the one side the amount of fertilizer needed for reaching the needed yield is possible. In group with phosphoric fertility of less than 3 ppm the amount of phosphorus has been suggested to be more than the need of canola. Also in the fertilizing group of too much phosphorus, even though there is a chance of plant does not show any reaction to super phosphate triple fertilizer, but there are different methods of fertilizer management have been suggested. Mixing super phosphate triple fertilizer with animal manure or use of fertilizer in strap is very important. Even though it has been suggested that in the group with too much fertilizing phosphor, the phosphor has not been used which is because of reduction in the environmental destruction. Also if the amount of phosphorus absorbed by the soil is less, the plant will obtain its needed phosphorus from phosphate fertilizer and from the soil with high phosphorus. Plants do not show any special reaction

Table 2. Effect of different amount of phosphorus fertilizer on canola yield in the soils with differen amount of absor bable phosphorus and determination of mitscherlich equation coefficient.

Agricultural year 2009-2010	P_2O_5 Amounts used (kg in acre)				Yield increase kg/ha	Absorbable phosphorus in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}				P_2O_5 25	P_2O_5 50
	Yield (kgs)								
Row	Y_0	Y_1	Y_2	Y_3			b		
1	604/5	467/5	546/8	537/8	-66/7	2/06	-	0/8861	-
2	594/5	628	578	675/75	81/25	2/08	0/9208	-	0/8539
3	696/75	647/25	657/75	692	-4/75	2/7	-	-	-
4	662	550/5	667/75	726/5	64/5	2/03	-	0/6198	1/097
5	619/5	545/5	519/25	522/5	-97	4/73	-	-	-
6	665/25	544/75	492/25	756/75	91/5	4/04	0/9208	0/5528	0/4560
7	523/75	455/5	511/75	623/75	100	5/43	0/7959	0/5686	0/7445
8	492/25	333/5	430/5	636/75	144/5	4/67	0/6383	0/3188	0/4949
9	594/5	615/75	524/5	417/75	-176/75	8/4	-	-	-
10	661/5	850/25	541/75	494/75	-166/75	8/64	-	-	-
11	798	730	652/75	502/25	-295/75	7/64	-	-	-
12	762/25	627/75	606/75	538/25	-224	8/49	-	-	-
13	530/25	518/5	896/5	735/5	205/25	12/44	0/5528	0/5229	-
14	545/75	500	912/5	847/25	301/5	11/28	0/4437	0/3872	-
15	639/75	575	1050/25	856/25	216/5	12/08	0/6021	0/4815	-
16	795	624/25	916/5	829/50	34/5	11/49	-	0/6021	-

Table 3. Effect of different amount of phosphorus fertilizer on canola relative yield in the soils with differen amount of absor bable phosphor and determination of mitscherlich equation coefficient.

Agricultural year 2008-2009	P_2O_5 Amounts used (kg in acre)				Yield increase kg/ha	Absorbable phosphorus in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}				P_2O_5 25	P_2O_5 50
	Relative yield								
Row	Y_0	Y_1	Y_2	Y_3			b		
1	124	91	101	100	-87/5	2/06	-	-	-
2	73	107	85	100	127	2/08	0/0437	-	0/0165
3	122	108	103	100	-95/25	2/7	-	-	-
4	112	81	88	100	-57	2/03	-	0/0288	0/0184
5	99	63	62	100	6	4/73	-	0/0173	0/0086
6	84	84	66	100	92/5	4/04	0/0315	0/0318	0/0094
7	96	75	73	100	19/5	5/43	-	0/0241	0/0114
8	95	75	73	100	25/5	4/67	-	0/0241	0/0089
9	94	64	64	100	27/25	8/4	-	0/0177	
10	110	115	106	100	-50/25	8/64	-	-	-
11	139	108	103	100	-197/25	7/64	-	-	-
12	126	105	96	100	-135	8/49	-	-	-
13	57	49	83	100	-352/75	12/44	0/0047	0/0117	0/0154
14	76	64	109	100	166	11/28	0/0087	0/0117	-
15	81	62	116	100	138	12/08	0/0095	0/0168	-
16	94	70	105	100	39/25	11/49	-	0/0209	-

phosphate fertilizer and obtained its needed phosphorus mainly from the sources close to it. Therefore this matter also must be considered in the phosphorus fertilizer in lime soil with high phosphorus. Because according to the environmental condition and balance in the nutrition is important in the group fertility.

Table 4. Effect of different amount of phosphorus fertilizer on canola relative yield in the soils with differen amount of absor bable phosphor and determination of mitscherlich equation coefficient.

Agricultural year 2009-2010	P_2O_5 Amounts used (kg in acre)				Yield increase kg/ha	Absorbable phosphorus in soil (ppm)	C_1	C	
	X_0	X_{25}	X_{50}	X_{75}					
	Relative yield							P_2O_5 25	P_2O_5 50
Row	Y_0	Y_1	Y_2	Y_3			b		
1	112	87	102	100	-66/7	2/06	-	0/0356	-
2	88	93	86	100	81/25	2/08	0/0780	-	0/0171
3	101	94	95	100	-4/75	2/7	-	-	-
4	91	76	92	100	64/5	2/03	-	0/0248	1/0219
5	119	104	99	100	-97	4/73	-	-	-
6	88	72	65	100	91/5	4/04	0/0365	0/0221	0/0019
7	84	73	82	100	100	5/43	0/0234	0/0227	0/0149
8	77	52	68	100	144/5	4/67	0/0219	0/0128	0/599
9	142	147	126	100	-176/75	8/4	-	-	-
10	134	117	109	100	-166/75	8/64	-	-	-
11	159	145	130	100	-295/75	7/64	-	-	-
12	142	117	113	100	-224	8/49	-	-	-
13	72	70	122	100	205/25	12/44	0/0071	0/0209	-
14	64	59	108	100	301/5	11/28	0/0062	0/0155	-
15	75	67	123	100	216/5	12/08	0/0080	0/0193	-
16	96	75	110	100	34/5	11/49	-	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 phosphor (ppm)	Farms within groups	Fertilizing soil group compare to phosphorus available in soil
36	23	41	7/9	2/8	40	0/5	112	2/06	1	
32	26	42	7/5	2/89	40	0/65	121	2/03	2	Less then 3 ppm
30	27	43	7/8	2/3	43	0/75	118	2/8	3	
30	25	45	8/02	2/76	38	0/4	115	2/5	4	
30	29	41	7/52	3/04	40	0/75	160	4/04	1	
22	34	46	7/51	2/5	42	0/52	158	5	2	3-6 ppm
20	28	52	7/8	2/8	39	0/61	169	4/5	3	
28	30	48	7/61	3/2	44	0/68	143	4/02	4	
30	29	41	7/7	3/3	42	0/62	180	8/4	1	
30	31	39	7/6	3/5	45	0/72	196	8/21	2	6-10 ppm
28	32	40	7/5	2/8	40	0/77	203	7/5	3	
28	30	42	7/8	3/5	46	0/65	206	8/3	4	
32	26	48	8/1	2/6	47	1/11	238	12/44	1	
34	25	41	7/6	3/5	46/4	1/15	235	14/4	2	More than 10 ppm
30	28	42	7/4	3/4	42	1	320	16/5	3	
28	32	40	7/9	2/6	45/2	0/9	316	12/5	4	

More phosphorus used in the soil, the fertility of the plant is more since that depends on this source and the other far away sources will not be used. But is the phosphorus in the area is less, opposite of this will take place.

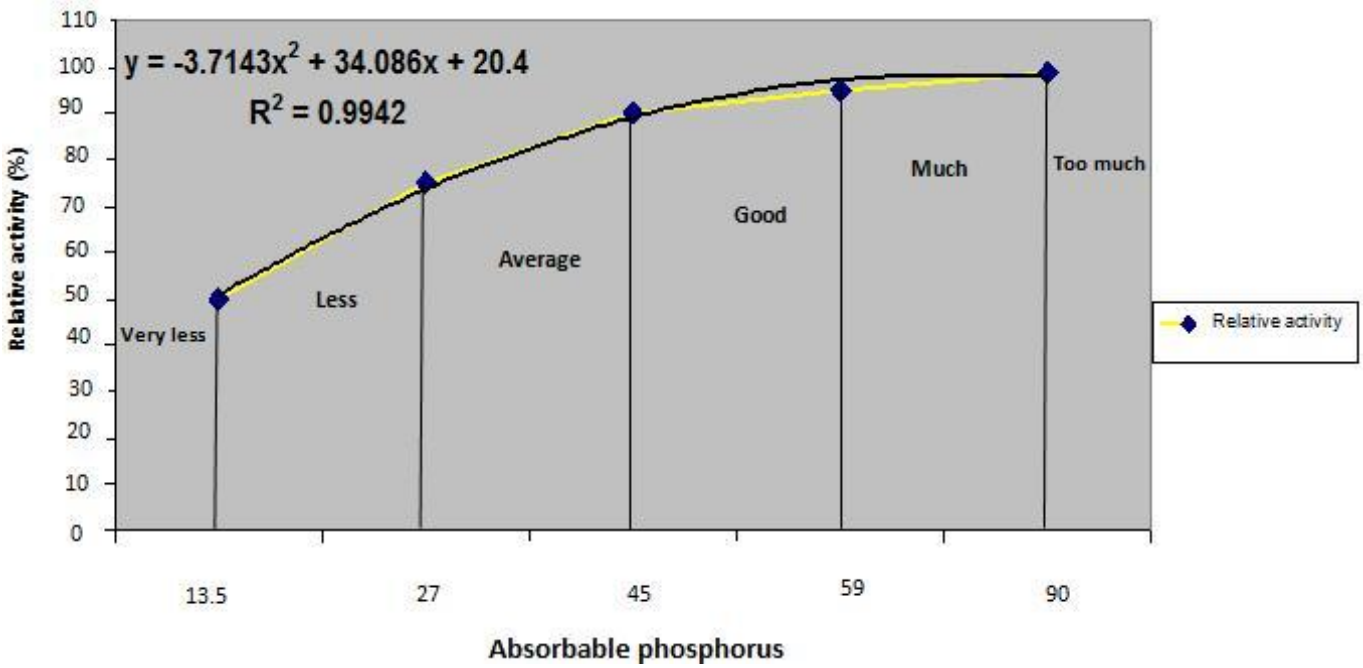

Figure 1. Calibration curve between relative activity and absorbable phosphate in soil (kg).

Table 6. The amount of fertilizer needed for different amount of soil phosphor and percentage of function.

Phosphorus absorbable in soil	Phosphorus absorbable in soil p.p.m	Sufficiency percentage	Degree of decomposing fertilizing index	The P_2O_5 amount needed in kg in acre for relative yield				
				90	92	94	96	98
6/25	1	14	Very less	47	53	59	69	85
13	2	46	Very less	39	44	51	61	77
19	3	63	Less	32	37	44	53	70
25	4	74	Less	24	30	36	46	63
31	5	84	Average	17	23	29	39	55
38	6	93	Much	9	14	21	30	47
44	7	99	Too much	1	6/5	13	23	40

Table 7. Fertilzer suggestion according to soil test in dryland farming canola in Behbahan.

Triple super phosphate Kg in acre	P_2O_5 Kg in Acre	Phosphor (milligram in kg)	Decompozing degree and fertilizing index
130	60	< 3	Less
96	44	3-5	Average
54	25	5-7	Much
-	-	<7	Too much

Melekoti and Homaei (2004) and Ukrainetz et al. (1975) also said that the canola plants reaction to phosphorus fertilizer differs according to the type of soil and moisture. Also Sandhu and Singh (1960), Gupta and Das (1973) and Sharma (1968) in their research showed that the canola plant reaction to the (0) phosphorus fertilizer is not completely predictor since the seasonal differences and soil's phosphor condition is not always measureable.

Melekoti and Homaei (2004) mentioned that in suggestion of phosphorus fertilizer, in addition to the

amount of phosphorus useable in the soil, some other specifications of the soil also must be considered such as active lime. Moisture, organic materials and the soils texture (- context) area's condition type of plant expected yield and the other amount of nutritional materials.

Resulting

According to the test, it can be said that fertilizer suggestion differs according to the degree of soil fertility in different groups of phosphorus which is absorbable in the soil (less than 3 ppm, 3 to 5 ppm, 5 to7 ppm and more than 7 ppm are 60, 44, 25, and 0 kgs P_2 O_5 per acre respectively). Also it seems that the method of soil testing has more attention to the natural resources and environment, and therefore it has been suggested that in fertilizer recommendation the economical matter should be considered apart from test method.

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