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Improving Filter Mud Cake with Rock Phosphate and Biofertilizers for Exporting Organic Onion Production in Newly Cultivated Land at South Valley Area.

A.A. Abo-Baker Basha

Soil and Water Department, Faculty of Agriculture South Valley University

Abstract: Two field experiments were carried out during two successive seasons of 2009/2010 and 2010/2011 in the organic experimental farm of Agriculture research center, Faculty of Agriculture, Qena, South Valley University. The aim of this study to evaluate the effect of improving locally organic material (filter cake mud byproduct of sugar factory) which incorporated with biofertilizer on exportable organic onion bulbs production under Egyptian condition. Four different composted Filter mud cake rates supplemented with 125 kg rock phosphate and with or without addition of nitrogen fixers and phosphate dissolving bacteria. The important obtained results are as that using Filter cake mud compost for growing onion plant gained the vigor growth and yield especially when associated with the biofertilizer. The results show that application biofertilizers plus filter mud cake improved its power for supplying Onion plants with nutrients and produced good quality exportable organic onion through enhancement vegetative plant growth. The application of biofertilizer plus 10 ton/fed induced highly significant increase in most growth parameters and resulted in a significant increase in total and exportable bulb yield under newly cultivated land at south valley area.

Key words: Organic onion, bio-fertilizer, Filter mud cake, plant growth and yield.

INTRODUCTION

Onions are the most used flavorings vegetable in the world and references to their history go back 5000 years or more with Chinese cultivation, 3500 BC for the Egyptians.

Efforts are being focused on measures that lead to a significant increase in quality of exportable crop production. Among the many factors for good organic production involved in achieving this aim are the balanced fertilization and the adoption of suitable fertilizer use practices.

The newly Egyptian soils especially in Upper Egypt are very poor in their organic matter content which less than 0.1 % in newly reclaimed soils.

The production of the best yield requires that the soil must have favorable physical, chemical nutritional and biological conditions.

Many investigations were carried out to study the response of some vegetables productivity to the application of organic manures as denoted by Abdel-Moez *et al*., 2001; Abdel-Mouty, *et al*., 2001; El-Desuki, and Sawan 2001; Abou-Hussein, *et al*., 2002 (on potatoes); Ghoname, and Shafeek, 2005 (on sweet pepper); Aisha, *et al*., 2007; Shaheen, *et al*., 2007; El-Mancy, *et al*., 2008; Gomba, *et al*., 2008; Abou El-Magd, *et al*., 2008 (on sweet funnel), and Abou El-Magd, *et al*., 2009 (on Broccoli crop); as well as Ahmed *et al*., 2009.

In addition, adding organic and bio-fertilizer had beneficial return to increase population of microorganisms especially in the surface layer-root rhizosphere, that produce substances, which stimulate plant growth.

Several investigators studied the role of organic manures, which incorporated with bio-fertilizer as stimulating the plant growth yield of vegetables. In Egypt, such as Warade, *et al*., 1996, Abdalla, *et al*., 2001 on pepper; Tantawy *et al*. 2001 on tomatoes; Safia Adam, *et al*., 2002 on cantaloupe; Fatma, *et al*., 2003 on squash; Shaheen *et al*., 2005 on onion. Also, Jayathilake, *et al*., 2003 in India; Tadav *et al*., 2005 india studies the response of onion plant to mixing bio-fertilizer with organic fertilizers.

The aim of this study to evaluate the effect of improving locally organic material (filter cake mud byproduct of sugar factory) which incorporated with biofertilizer on exportable organic onion bulbs production.

Corresponding Author: A. Abo-baker Basha Soil and Water Department, Faculty of Agriculture South Valley University

MATERIALS AND METHODS

The experiment was conducted during the successive seasons 2009/2010 and 2010/2011 in the organic experimental farm of Agriculture research center, Faculty of Agriculture, Qena, South Valley University, which located at latitude 26°11' 25 N", and longitude 32° 44' 42" E, in hyper hot dry zoon around the tropic of cancer to investigate the effect of application of 4 rates of filter cake mud supplemented with 125 Kg rock phosphate 31%P2O5 with and without application of pho on growth, bulb yield and Exportiable values of onion organically production.

The treatments of experiment were as follows:
Control. (without any addition).
Filter cake mud (2.5 ton / fed).
Filter cake mud (5 ton / fed).
Filter cake mud (7.5 ton / fed).
Filter cake mud (10 ton / fed).
Filter cake mud (2.5 ton / fed) + Biofertilizer.
Filter cake mud (5 ton / fed) + Biofertilizer.
Filter cake mud (7.5 ton / fed) + Biofertilizer.
Filter cake mud (10 ton / fed) + Biofertilizer.

Soil Sampling and Analysis:

Determinations of the physical and chemical properties were conducted on composite soil samples taken from the top surface soil to depth of 30 cm. Table (1) shows the obtained data of the representative soil samples taken from the experimental site.

Table 1: Some physical and chemical properties of representative soil samples from the experimental site.

Soil properties		Value
Mechanical analysis	Clay %	7.66
	Silt %	2.14
	Sand %	90.20%
Texture grade		Sandy
Total $CaCO_3$ %		8.5
ECe dS m^{-1}		2.55
Soil water Saturation %		22.4
pH (1:1 suspension)		8.16
Soluble cations		
Ca^{++} meq/100 g soil		9.1
Mg^{++} meq/100 g soil		6.6
Na^{+} meq/100 g soil		9.9
K^{+} meq/100 g soil		0.6
Soluble anions		
$CO_3^{=}$ + HCO_3^{-} meq /100 g soil		7.7
Cl^{-} meq/100 g soil		7.4
$SO_4^{=}$ meq /100g soil		10.0
OM %		0.144
N-Total %		0.0022
C/N Ratio		37.964
Total P %		0.0024
Total K %		0.038

Soil texture was determined using the pipette method (Piper, 1950). Soil total N content was determined by the micro-kjeldahl method as recommended by Bremner and Mulvany (1982). Available phosphorus was determined by the chlorostannous phosphomolybdic acid method using the bicarbonate extraction technique (Jackson, 1973). Soil pH was measured by a pH meter in 1:1 soil-water suspension (Jackson, 1973). Total carbonates were determined using the calcimeter method (Nelson, 1982).

Total soluble salts were determined in the water paste extract of the soil by the electeric conductivity method (Jackson, 1973) using a Conductivity Measuring Bridge; Type M.C.3.

Determinations of the soluble cations and anions in the soil paste extract were performed using the following methods:

- Na^+ and K^+ by the flame photometer, CORNING 410, (Jackson, 1973).
- Ca^+ and Mg^{++} by titration with EDTA solution, (Richards, 1954).
- Carbonate and bicarbonate by titration with HCl, (Jackson, 1973).
- Chloride by titration with silver nitrate solution (Jackson, 1973).
- Sulphate by the turbidimetric method using barium chloride (Jackson, 1973)

The layout of experimental treatments in the field was a complete randomizes block design with 4 replicates in the first season and in the second season. Onion seedlings cv. Giza (6), two month old, were purchased from the local onion nursery of Qena area (Esna).

125 kg /fed. of 31.0% P_2O_5 of rock phosphate was mixed with Organic Filter cake mud treatments (contain 2.3% N, 2.5% P and 0.31K) which dressed during soil preparation and before transplanting. The biofertilizers were mixed with the Filter cake mud befor planting by adding 1 liter of both of *Azotobacter chrocoochum*, *Azospirillum brasilense* and phosphate dissolving bacteria (*Bacillus polymyxa*) liquid culture which prepared at the biofertilizers production unit of faculty of agriculture south valley university. The microorganism was obtained from the author in previous study (Abo-Baker 1996 and 2003).

Onion seedlings were transplanted on the last week of December for the two successive experimental seasons under drip irrigation system.

Onion seedlings, were transplanted on both sides of the ridge (50 cm between ridges) at 10 cm distance between plants. The approximate plant population was 131.000 plants per feddan.

The normal after planting agricultural practices of onion production commonly used as in the growing area, and the following data were recorded.

A. Plant Growth:

After 70 days from planting date, samples of 5 onion plants were taken randomly from each experimental plot, for determination of: plant height, foliage fresh and dry weights, bulb fresh and dry weights, roots fresh and dry weight and total plant fresh and dry weights.

B. Nutritional Elements:

Dry samples foliage and bulb (70 days old) from each experimental plot were taken for elemental analysis, where N, P and K elements in the dry matter of bulbs tissue were determined.

C. Bulb Yield and its Components:

At harvesting time the total bulbs yield were weighed, and then separated to exportable yield (bulbs with diameter within 4-6 cm) and locally marketable yield (bulbs with diameter less than 4 cm and more than 6 cm), finally, the weights of different above categories were accounted as tons/fed.

Statistical Analysis:

All data obtained were subjected to proper statistical analysis of variance according to the procedure outlined by Gomez and Gomez (1984). The differences between means of the different treatments were compared using the least significant difference. (L.S.D.) at 5% and 1% probability.

RESULTS AND DISCUSSION

Plant Growth:

Onion plant growth parameters expressed as plant height, foliage fresh and dry weights, bulb fresh and dry weights, roots fresh and dry weight and total plant fresh and dry weights. whole plant as well as diameter of bulb affected by the application of various Filter cake mud rates in comparison with the control or with the application of the same treatment with or without biofertilizers. Table (2) and (3) for the two successive seasons. The results showed that, in comparison with the control treatment, all Filter cake mud rates with or without Biofertilizers produced further promotive effects on vegetative plant growth, while these treatments plus biofertilizers recorded significantly heighest values in most parameters. This magnified promotions induced by biofertilizers indicate synergetic interactions between them.

Data of the first season as shown in table (2) revealed that, in both seasons, the best height was recorded only in case of application 7.5 and 10 Ton / fed. without biofertilizers, while, all rates of Filter cake mud plus biofertilizer recorded significant increases reached to 27.82%, 36.48%, 52.24% and 55.38% for 2.5. 5, 7.5 and 10 ton / fed. respectively. Also, the data showed that no significant differences in plant height were found within or between treatments either with or without biofertilizer. The results of the second season recorded the same trends that obtained in the first season.

Table 2: Effect of different Filter cake mud rates with and without biofertilizers on the vegetative growth characters of onion plant during the season of 2009/2010.

Treat. No.	Treatments	Plant height (cm)	Bulb diameter (cm)	fresh weight g / plant				Dry weight g / plant			
				bulb	foliage	roots	hole plant	bulb	foliage	roots	hole plant
T1	1. Control.	38.1	2.4	12.8	15.8	1.407	29.977	1.933	1.9	0.12	3.987
T2	2. Filter cake mud (2.5 ton/fed).	43.1	2.73	18.48	21.2	1.8	41.143	2.787	3.467	0.22	6.473
T3	3. Filter cake mud (5 ton /fed).	43	3	28.32	27.6	1.81	57.993	4.937	3.967	0.23	9.133
T4	Filter cake mud (7.5 ton/fed)	57.3	3.33	31.93	36	2.52	71.12	5.987	4.367	0.38	10.733
T5	4. Filter cake mud (10 ton/fed).	58.3	3.57	35.46	43.2	3	85.433	7.77	5.233	0.51	13.543
T6	Filter cake mud (2.5 ton/fed) #NAME?	48.7	3.03	25.9	28.6	2.54	57.07	4.143	3.633	0.353	8.13
T7	Filter cake mud (5 ton/fed) #NAME?	52	3.73	35.49	39.5	3.33	78.19	6.367	5	0.517	11.833
T8	Filter cake mud (7.5 ton/fed)+Biofertilizer	58	4.1	40.5	47.8	3.7	91.933	7.55	5.6	0.557	13.707
T9	Filter cake mud (10 ton/fed)+Biofertilizer	59.2	4.3	42.2	59.4	4.2	105.9	10.88	6.66	0.64	18.04
	L.S.D.										
	0.05	7.742	0.5585	6.689	11.79	1.1	13.77	2.137	0.6349	0.1329	2.329
	0.01	10.61	0.7652	9.165	16.15	1.532	105.9	2.928	0.8699	0.182	3.191

Table 3: Effect of different Filter cake mud rates with and without biofertilizers on the vegetative growth characters of onion plant during the seasons of 2010/2011.

Treat. No.	Treatments	Plant height (cm)	Bulb diameter (cm)	fresh weight g / plant				Dry weight g / plant			
				bulb	foliage	roots	hole plant	bulb	foliage	roots	hole plant
T1	Control.	40	2.1	12.74	17.4	1.607	31.75	1.93	2.2	0.13	4.223
T2	Filter cake mud (2.5 ton/fed).	53	2.7	18.17	31.3	2.1	51.6	2.21	3.8	0.2	6.21
T3	Filter cake mud (5 ton/fed).	55.3	2.9	30.5	35.6	2.3	68.4	4.4	4.1	0.23	8.73
T4	Filter cake mud (7.5 ton/fed)	59.3	3	32.4	38.4	2.66	73.46	4.6	4.7	0.33	9.63
T5	Filter cake mud (10 ton/fed).	59.7	3.3	36.17	45.8	2.99	84.957	5.6	5.4	0.45	11.45
T6	Filter cake mud (2.5 ton/fed)+ Biofertilizer	58	3.1	24.1	35.33	2.4	61.833	3.8	4.7	0.29	8.757
T7	Filter cake mud (5 ton/fed)+ Biofertilizer	57.7	3.3	36	42.5	3.5	82	6.33	5	0.52	11.887
T8	Filter cake mud (7.5 ton/fed)+ Biofertilizer	59	3.5	42.5	45.7	3.7	91.9	8.22	5.5	0.57	14.27
T9	Filter cake mud (10 ton/fed)+ Biofertilizer	60	3.7	44.5	52	3.9	100.4	8	6	0.63	14.63
	L.S.D.										
	0.05	5.344	0.5315	4.3.23	5.641	0.1270	7.573	0.6688	0.7536	0.0246	1.209
	0.01	7.321	0.7282	5.923	7.729	0.2973	8.956	0.9163	1.033	0.03324	1.657

With regard to the bulb diameter, the results showed the similar results as that obtained in case of plant height in both season except of that rates of 7.5 and 10 ton / fed. plus biofertilizer for first season recorded a significant increase reached to 23.1% and20.45% comparing with 7.5 and 10 ton/fed. without biofertilizer, while the differences between these increases in the second season was not significant.

On the other hand, the heighest bulb and foliage fresh weight was recorded with application of all rates of Filter cake mud either with or without application of biofertilizers. The application of all Filter cake mud rates plus biofertilizer recorded the best bulb, foliage fresh weight comparing with these treatments alone without biofertilizer. The application of biofertilizer plus 5, 7.5 and 10 ton / fed. in the first season recorded increases reached to 43.12 %, 32.87 %, and 37.5 % for foliage fresh weight and 25.31%,26.84%,19.01% for bulb fresh weight comparing with 5, 7.5 and 10 ton Filter cake mud / fed. without biofertilizers respectively. The same trend was found in season two.

Also, roots fresh weight results recorded that only application of biofertilizer plus Filter cake mud gave the heighest roots fresh weight comparing with control or with the same filter cake mud rates without biofertilizers. The best increase in roots fresh weight was found in case of application biofertilizer plus 10 ton /fed. which recorded increasing reached to 40.0% for the first season and 30.43% for second season comparing with the same treatment without biofertilizer.

Regarding to hole plant fresh weight, data in table (2) and (3) showed that in both season all treatments except of 2.5 ton / fed alone in the first season recorded significant increase on hole plant fresh weight comparing with control. It is interesting to notice that all filter cake mud rates plus biofertilizers recorded a significant increases more than filter cake mud rates alone. These increases was 38.7%, 34.83%, 29.26% and 23.96 % for 2.5, 5, 7.5 and 10 ton / fed comparing with these treatments without biofertilizer. The same trend was obtained in case of season two.

With regard to bulb and foliage dry weight in the two season, data in table (2) and (3) showed that, the foliage dry weight significantly affected with application all filter cake mud rates with or without biofertilizer. In general, the best foliage dry weight was recorded in case of application all treatment plus biofertilizer. The heighest bulb and foliage dry weight was found in case of application 10 ton filter cake mud rates plus biofertilizer.

Roots dry weight also recorded significant response as a results of application all Filter cake mud rates, this effect was more pronounced in Filter cake mud treatrments supplemented with biofertilizer, the best significantly roots dry weight was found in case of application 10 ton plus biofertilizer.

Results of hole plant dry weight showed that, all filter cake mud rates caused significant increases in whole plant dry weight. The treatments received filter cake mud plus biofertilizer was significantly higher than those with filter cake mud alone.

The heighest hole plant dry weight was found in case of application 10 ton / fed plus biofertilizers followed by 7.5 ton plus biofertilizers and reached to33.21% and 27.71 % respectively for the first season and reached 27.78 and 48.18% for the second season comparing with filter cake mud rates of 10 and 7.5 ton / fed. without biofertilizer for the two season respectively.

Generally, it could be concluded that, using biofertilizers plus filter cake mud resulted more vigor growth for onion plants when compared to the use the filter cake mud rates alone.

These finding are in good accordance with that which obtained by Abdel-Moez *et al*.,1997; El-Desuki, and Sawan, 2001; Shaheen,*et al*.,2007; Vutien Khang *et al*., 2010 on onion plants.

Chemical Properties of Bulbs Yield:

The presented data in Table (4) and (5) indicate that, the different rates of filter cake mud with and without biofertilizers influenced the nutritional elements of onion hole plant tissue in both experimental seasons. Whereas, the application of 10 Ton / fed recorded the highest values of N%, P% and K% in onion plant with or without biofertilizer, followed in descending order by that plants which received 7.5 and 5 Ton/fed in both two experimental seasons, while the lowest values were recorded with the application of 2.5 ton / fed. which recorded nonsignificant increase. These findings were true in both season comparing with control treatment

Table 4: Effect of different filter cake mud rates with or without biofertilizer on the mineral contents of onion during the season of 2009/2010.

Treat.No.	Treatments	N% in hole plant	Total N-content mg/plant	P% in hole plant	Total P-content mg/plant	K% in hole plant	Total K-content mg/plant
T1	Control.	0.428	16.65	0.128	5.111	0.208	8.284
T2	Filter cake mud (2.5 ton/fed).	0.661	42.597	0.18	11.701	0.298	19.293
T3	Filter cake mud (5 ton/fed).	0.950	86.919	0.25	22.681	0.42	38.207
T4	Filter cake mud (7.5 ton/fed)	1.130	121.065	0.31	33.119	0.548	54.533
T5	Filter cake mud (10 ton/fed).	1.400	188.287	0.34	45.708	0.6	81.294
T6	Filter cake mud (2.5 ton/fed) + Biofertilizer	0.773	62.864	0.24	19.511	0.301	24.471
T7	Filter cake mud (5 ton/fed) + Biofertilizer	1.150	136.838	0.31	36.907	0.42	49.973
T8	Filter cake mud (7.5 ton/fed) + Biofertilizer	1.257	172.4	0.41	56.174	0.558	76.494
T9	Filter cake mud (10 ton/fed) + Biofertilizer	1.680	303.078	0.45	81.174	0.61	110.044
L.S.D.							
0.05		0.143	29.65	0.03116	7.080	0.01799	12.42
0.01		0.1966	40.6	0.04269	9.700	0.02465	17.02

Table 5: Effect of different filter cake mud rates with or without biofertilizer on the mineral contents of onion during the season of 2010/2011.

Treat.No.	Treatments	N% in hole plant	Total N-content mg/plant	P% in hole plant	Total P-content mg/plant	K% in hole plant	Total K-content mg/plant
T1	Control.	0.427	19.918	0.136	5.744	0.222	9.376
T2	Filter cake mud (2.5 ton/fed).	0.668	41.479	0.178	11.026	0.298	18.504
T3	Filter cake mud (5 ton/fed).	0.918	80.141	0.244	21.301	0.408	35.618
T4	Filter cake mud (7.5 ton/fed)	1.032	99.384	0.284	27.348	0.463	44.588
T5	Filter cake mud (10 ton/fed).	1.244	140.385	0.297	34.006	0.52	59.454
T6	Filter cake mud (2.5 ton/fed)#NAME?	0.832	72.855	0.244	21.272	0.324	28.372
T7	Filter cake mud (5 ton/fed)#NAME?	1.154	137.185	0.31	36.849	0.422	50.149
T8	Filter cake mud (7.5 ton/fed) + Biofertilizer	1.32	188.364	0.365	52.111	0.495	70.643
T9	Filter cake mud (10 ton/fed) + Biofertilizer	1.362	199.221	0.431	63.055	0.519	75.845
L.S.D.							
0.05		0.05425	13.46	0.04202	4.497	0.0420	5.744
0.01		0.07432	18.44	0.05757	6.161	0.05757	7.869

The results showed the effect of biofertilizer in raising N% and P% of onion plant, while no significant increase recorded in case of K%. Also the results showed that addition of biofertilizer plus filter cake mud caused significant increases in nutrient percentage and content with rate of 5, 7.5 and 10 ton / fed. comparing with the same rates without biofertilzer.

It could be concluded that, the highest N, P and K-content were obtained with the application of 10 Ton / fed. plus biofertilizer followed with 7.5 Ton / fed. This result was true in the two experimental seasons. It worthy to mentioned that, using these filter cake mud rate of plus biofertilizers recorded the best nutrients content.

Total Bulbs Yield and its Components:

Data in table (6) showed that, highly significant increases were recorded in total bulb yield as a results of application different filter cake mud rates with or without biofertilizer. In the first season these increase reached to 58,65%, 123.8%. 145.33% and 200.8 % for application 2.5, 5, 7.5 and 10 ton / fed. respectively, while these increases reached to 60.41%, 149.7%, 170.51% and 295.14% for application the previous treatments plus biofertilizer respectively. The data in table (6) showed that application of biofertilizer plus filter cake mud raise the total onion bulb yield comparing to the total onion bulb of filter cake mud without biofertilizer and recorded significant increases. The yield of the second season recorded the same trend

obtained in the first season. The best increase recorded with 10 ton / fed plus biofertilizer which reached to 31.4% for first season and 25.7% for second season comparing the same treatment without biofertilizer. On the other hands, the results showed that the yield and percentage of exportable onion bulb was higher in all treatments received biofertilizer except of 2.5 ton / fed. than those without biofertilizer. The heighest exportable percentage was recorded in case of application 5, 7.5 and 10 ton/fed plus biofertilizer comparing with the same treatments without biofertilizer without significant differences between them.

Its clearly to show that, the total bulbs yield and its components affected by addition of differences the filter cake mud plus biofertilizers in the two seasons of 2009/2010 and 2010/2011.

It's evident that the heaviest tonnages of total bulbs yield and its components are associated with that onion plants which supplied 10 ton/fed + biofertilizer which resulted in the heaviest exportable bulbs yield reached to 8.66 and 8.82 tons/fed. meeting 91.72% and 94.0% from total bulb yield for the first and second season respectively and recorded high value as exportable product which increase the total income comparing with local market price.

These findings are in good accordance with Shaheen *et al.*, 2007; Amal, *et. al.*, 2010; Abdel-Moez *et al*., 1997; Abou-Hussein, *et al*., 2002; Hassan, 2002; Mondal, *et al*., 2004 ; Aisha, *et al*., 2007 and El-Mancy, *et al*., 2008.

Table 6: Effect of different filter cake mud rates with or without biofertilizer on onion yield and its components in the two seasons of 2009/2010 and 2010/2011.

Treatments	Bulbs yield (Ton/fed.) First season				Bulbs yield (Ton/fed.) Second season			
	Total	Exportable	Local consumption	Exportable %	Total	Exportable	Local consumption	Exportable %
T1	2.387	0.000	2.387	0.000	2.722	0.000	2.722	0.000
T2	3.787	0.333	3.454	9.027	4.594	1.549	3.045	33.717
T3	5.342	3.204	2.138	59.957	6.014	3.770	2.244	62.69
T4	5.856	4.611	1.245	69.673	6.824	4.583	2.241	67.16
T5	7.179	5.720	1.459	73.443	7.400	5.340	2.060	72.162
T6	3.829	0.798	3.031	21.215	4.852	1.700	3.152	35.283
T7	5.960	5.442	0.518	91.252	6.410	5.853	0.557	91.283
T8	6.457	5.918	0.539	9.656	7.363	7.723	0.640	91.308
T9	9.432	8.663	0.769	91.721	9.301	8.820	0.481	94.796
L.S.D.								
0.05	1.363	1.646	1.191	14.78	1.819	2.372	1.781	14.23
0.01	1.867	2.255	1.632	20.26	2.492	3.250	2.440	94.796

Conclusion:

The results show that application of biofertilizers plus filter cake mud improve its power for supplying Onion plants with nutrients and produced good quality exportable organic onion through enhancement vegetative plant growth. The application of biofertilizer plus 10 ton/fed induced highly significant increase in all growth parameters and resulted in a significant increase in total and exportable bulb yield under newly cultivated land at south valley area.

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