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Optimum dose of phosphorus and potassium for increased yield and quality in garlic under Akola condition

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ABSTRACT

The experiment was conducted during the year 2008-09 on Agrifound white variety of garlic to find out an optimum dose of phosphorus and potassium. The yield and yield attributing characters like bulb weight, size of bulb and cloves per bulb were found maximum with application of 125 kg phosphorus and 75 kg potassium ha^{1}, respectively. While in present investigation an application 89.13 kg phosphorus and 67.66 kg Potassium ha^{1} was considered as economically optimum. The maximum benefit cost ratio was 1.12 and 1.22 with an application of 125 kg phosphorus 75 kg potassium ha^{1}, respectively.

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Key words : Optimum dose, Garlic

INTRODUCTION

Garlic (*Allium sativum* L.) belongs to family Aliceac. It is most important spice crop used for flavoring and seasoning of vegetable dishes throughout the world and in preparing chutneys, pickles, etc. It has higher nutritive value than other bulb crops, nutrients play an important role in improving productivity and quality of garlic bulbs. Phosphorus stimulates early root growth and development and hastens maturity of crop. Potassium has crucial role in energy status of plant translocation and storage of assimilates and maintenance of tissue water relation. The judicious use of chemical fertilizers is one of the well known tool for the maximization of bulb yield through their proper, rational and optimum doses (Naidu *et al.,* 2000). The present investigation was therefore, conducted to find out the optimum dose of phosphorus and potassium for obtaining better yield of garlic.

MATERIALS AND METHODS

The present investigation was conducted at Main Garden, Department of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in a Factorial Randomized Design with four replications. Four levels of phosphorus (0, 75, 100 and 125 kg ha^{1}) and potassium (0, 25, 50 and 75 kg ha^{1}) were tested with nitrogen 100 kg ha^{1} as a common dose. The garlic variety Agrifound white (G-14) was used. The garlic cloves were planted at 10x10 cm spacing in flat bed of plot size 3x1 m dimention on dated 8th October, 2008.

FYM @25 t ha^{-1} half dose of nitrogen in the form of urea, full dose of phosphorus in the form of single supar phosphate and full dose of potassium in the form of murate of potash (as per treatment) to each plot were applied as basal dose at the time of planting. Remaining half dose of nitrogen was applied as a top dressing, after one month from the date of planting.

The observations on yield and yield attributing parameters were recorded at harvest.

Optimum dose :

Generally, the response to phosphorus and potassium is quadratic *i.e.* yield increases at increasing rate with increasing in phosphorus and potassium dose up to a certain level and at a decreasing rate with subsequent doses of phosphorus and potassium. At a particular level, yield approaches to plateau and further increase in phosphorus and potassium dose decreases the yield (Reddy and Reddy, 2002).

Estimation of physical optimum dose:

The physical optimum dose of phosphorus and potassium was worked out with the following quadratic equation as suggested by Gomez and Gomez (1984).

$$Y = a + b_1P + b_2K + b_3P_2 + b_4K_2 + b_5PK$$

where
Y = Yield (q ha^{1})
a = intercept

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b_1 and b_3 : Regression coefficient represents phosphorus levels

b_2 and b_4 : Regression coefficient represents potassium levels

b_5 : Values of interaction.

An analysis of this equation is done by multiple linear regression for obtaining constants.

Estimation of economic optimum dose:

The economic optimum dose of phosphorus and potassium was worked out with the following equations.

$$x = \frac{q - Pb}{2Pc}$$

where

X = Economic optimum dose of phosphorus and potassium

q = Price of output i.e. garlic bulb @ Rs kg^{-1}

p = Price of input i.e. phosphorus @ Rs kg^{-1}

potassium @ Rs. kg^{-1}

For phosphorus $b = b_1$, $c = b_3$

For potassium $b = b_2$, $c = b_4$

Estimation of predicted yield:

The maximum predicted yield at physical and economic optimum dose was calculated by substituting coefficient of optimum values of P and K.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been presented under following heads :

Effect of phosphorus:

The data presented in Table 1 indicated that, an application of 125 kg phosphorus ha^{-1} (P3) produced the maximum fresh (121.83 qha^{-1}) and cured (115.16 qha^{-1}) bulb yield, bulb weight (21.59g), diameter (3.39 cm) and length (3.78 cm) of bulb and cloves per bulb (24.53). While application of 100 kg phosphorus ha^{-1} (P2) produced 118.54 qha^{-1} fresh and 111.87 qha^{-1} cured bulb yield which were at par with each other.

This increasing trend of yield and yield attributes might be due to phosphorus is an essential component of nucleic acids, pholipids, phyteen and some amino acids and it helped the formation of food resenrs due to higher photosynthetic activity. These results are in accordance with the findings of Pal and Pandey (1986) and Puttaraju (2004) in garlic.

Effect of potassium:

The data presented in Table 1 indicates that, an application of 75 kg potassium ha^{-1} sproduced maximum fresh (128.33 qha^{-1}) and curved (120.16 qha^{-1}) bulb yield, bulb weight (20.57), diameter (3.49 cm), length (3.81 cm) of bulb and cloves per bulb (27.25). While application of 50 kg potassium qha^{-1} produced 125 fresh and 118.33 qha^{-1} cured bulb yield which were at par with each other. The yield and yield attribute increased with each incremental level of potassium. This might be due to Potassium supply is seldom adequate to support crucial process such as sugar transport from leaves to bulbs, enzyme activation, protein synthesis. These results were also obtained by Mohmed (1994), Verma *et al.* (1996) and Puttaraju (2004) in garlic.

Quadratic equation:

It is fitted by the method of Orthogonal Polynomials

Table 1: Effect of Phosphorus and Potassium on yield and yield attributes of garlic

Treatments	Fresh bulb yield (qha^{-1})	Cured bulb yield (qha^{-1})	Bulb weight	Diameter of bulb (cm)	Length of bulb (cm)	Cloves per bulb	B:C ratio
Phosphorus(P)							
P_0(0 kg ha^{-1})	90.10	81.33	15.47	2.79	2.42	21.55	0.50
P_1(75 kg ha^{-1})	103.55	97.3 3	18.46	2.90	2.53	22.75	0.79
P_2(100kg ha^{-1})	118.54	111.87	19.36	3.19	2.81	23.67	1.06
P_3(125kg ha^{-1})	121.83	115.16	21.59	3.39	3.78	24.53	1.12
C.D. (P=0.05)	6.38	7.23	0.79	0.17	0.35	0.75	---
Potassium(K)							
K_0(O kg ha^{-1})	80.85	72.00	16.52	2.71	2.03	19.47	0.33
K_1(25 kg ha^{-1})	99.64	94.85	18.12	2.90	2.46	22.07	0.75
K_2(50 kg ha^{-1})	125.00	118.33	19.68	3.16	3.03	23.71	1.18
K_3(75 kg ha^{-1})	128.33	120.16	20.57	3.49	3.81	27.25	1.22
C.D. (P=0.05)	6.38	7.23	0.79	0.17	0.35	0.75	---

Table 2 : Multiple linear regression analysis of cured bulb yield of garlic

Variable	Coefficient of variable	Regression coefficient	SE (b)	't' value
Intercept	a	49.73		
P	b_1	0.2440	0.3 043	0.80
K	b_2	1.293	0.5091	2.54*
P2	b_3	-0.00064	-0.00232	0.27
K2	b_4	-0.006833	-0.005914	1.16
PK	b_5	-0.0015	-0.00282	0.53
---	R^2	0.79		

* indicates significance of value at P=0.05

by using following formula.

$$Y = a + b_1P + b_2K + b_3P_2 + b_4K + + b_5PK$$

By computing the figures, the fitted quadratic equation is as under.

$$Y = 49.73 + 0.2440\ P + 1.293\ K - 0.00064\ P^2 - 0.006833\ K^2 - 0.0015\ PK$$

Estimation of physical optimum:

Physical optimum dose of phosphorus and potassium was worked out by differentiating quadratic equation w.r.t. P and K.

The estimated values of physical optimum dose of phosphorus and potassium was 102. kg ha^{l} and 81.65 kg ha^{l}.

Estimation of predicted yield at physical optimum:

Substituting the values of physical optimum dose of phosphorus (Xp) and potassium (Xk) in response equation.

The predicted values of cured bulb yield of garlic at physical optimum dose of phosphorus and potassium were 113.39 q ha^{-1} and 122.30 q ha^{-1}, respectively.

Estimation of economic optimum:

The economic optimum dose of phosphorus and potassium was worked out as 89.13 kg ha^{-1} for P and K, respectively.

Estimation of predicted yield at economic optimum:

The estimated values of predicted cured bulb yield at economic optimum dose of phosphorus and potassium was 110 q ha^{-1} and 118.91 q ha^{-1}, respectively.

Optimum dose of phosphorus and potassium:

The maximum predicted cured bulb yield 113.99 q ha^{-1} was obtained at physical optimum dose of phosphorus (102 kg ha^{-1}), whereas economically viable cured bulb yield of 110 q ha^{-1} was produced at 89.13 kg ha^{-1}.

In case of potassium the maximum predicted cured bulb yield (122.30 q ha^{-1}) was obtained at physical optimum dose of potassium (81.65 kg ha^{-1}), whereas economically viable cured bulb yield 118.91 was produced at 67.66 kg ha^{-1}.

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