EFFECT OF MINERALS ON SOME BIOMETRICAL PARAMETERS OF GREEN HOUSE TOMATO

P.Tsolmon*, A.Choijamts

School of Agroecology, MULS

*email: p.tsol@yahoo.com

ABSTRACT

In the present study, the length of growth and developmental stages and some biometrical parameters of tomato grown in winter greenhouse were investigated in relation to mineral fertilizer doses and combinations. Results of the study demonstrated that flowering synchrony of both the variants $P_{150}K_{150}N_{150}$ and $P_{150}K_{150}N_{350}$, basic norms of nitrogen in which increased by 100 to 200 kg and the variants $N_{250}P_{250}K_{250}$, basic norms of triangular mineral fertilizer in which, increased by 100 kg was later by 5 to 10 days than the variants, which have no fertilizers and other combined doses. It also revealed growth of vegetative organs of the plant is stimulated, whereas the growth of reproductive organs inhibited. Investigation of growth rates of main stem of the tomato plant for each variants shows height of main stem is 368 cm for no fertilizer variant, 381 cm for $N_{150}P_{150}$, and 387 cm for $N_{150}P_{150}K_{250}$ variant, which is the tallest among other variants. It is taller by 19 cm than control.

Key words: *Growth, development, tassel, dose, combination*

INTRODUCTION

Protected soil has such specific nutritive features as relatively thinner soil layer, where the root is localized, loss of nutrients flushed via regular irrigation, soil structure loss, suppression of reproduction of soil microorganisms by frequent steam sterilization and soil salinization due to higher mineral norms.

In modern period green house production, the proper adjustment of doses and necessity of fertilizers during plant growth stages is the most important issue.

Goals and objectives of the study:

The present study aimed to investigate some biometrical parameters of tomato grown in winter green house in relation to doses of mineral fertilizers via achievement of the following objectives:

1. To investigate evenness and duration of developmental stage tomato in winter glass greenhouse in relation to doses and combinations of mineral fertilizers,
2. To investigate some biometrical parameters of tomato in winter glass greenhouse in relation to doses and combinations of mineral fertilizers.

MATERIALS AND METHODS

The experiment is performed as described in the following methodology on the plots of winter green house Agro-Amgalan LLC in Ulaanbaatar city.

In order to investigate optimal doses of mineral fertilizers and effect of the combinations, the following variants were chosen:

Control (no fertilizer)

1. $N_{150}P_{150}$
2. $N_{150}P_{150}K_{150}$
3. $N_{150}P_{150}K_{250}$
4. $N_{150}P_{150}K_{350}$
5. $N_{150}K_{150}$
6. $N_{150}K_{150}P_{250}$
7. $N_{150}K_{150}P_{350}$
8. $P_{150}K_{150}$
9. $P_{150}K_{150}N_{250}$
10. $P_{150}K_{150}N_{350}$
11. $N_{250}P_{250}K_{250}$
12. $N_{350}P_{350}K_{350}$

The study was conducted on a total of 520 individual plants or 10 for each plot or variant.

All observations and studies of the experiment were made in 4 replicates.

Experimental variants were localized randomly on the plots.

Russian variety Karlson was chosen and planted in the study. Variety Karlson is very strong, medium early hybrid plant of indeterminate type, 8 to 12 fruits grow on each tassel and a fruit weighs 80 to 90 g.

Planting scheme is 40+90+60+90+40ð30.

Variants of experimental fertilizer doses were used by hand spray in doses of active substances, then nitrogen and potassium fertilizer as an additional one is dissolved in water and used after planting.

Mineral fertilizers, including ammonium salt, double granule superphosphate, potassium phosphate are used.

The starting period of the growth and developmental stages of tomato plant was estimated in 20% of all plants, while evenness was estimated to be observed in 80% of all plants.

RESULTS OF THE STUDY

Stages of tomato growth and development, and their duration

Depending on the logistics and organizational activities for preparation of planting (repair and maintenance of heating system and greenhouse, adjustments for heating etc.) in greenhouse of Agro-Amgalan LLC, it was impossible to make plantings for the same period of time annually.

In the first year, the planting was the latest or on 26 December, in the second year, the planting was slightly earlier or on 20 December, and third year the planting was made on 11 December.

Regardless of planted day, the plants emerged evenly after 10 days. Observing the production technology to transplant tomato seedlings with 4 or 5 leaves on greenhouse plots, the seedlings were transplanted on 13 March at 78 days of age in the first year, 10 March at 71 days of age in the second year, and 02 March at 72 days of age in the third year on the plots fertilized and prepared previously for plantation according to methods of the experiment.

Changes of growth stage onsets of tomato seedlings after transplantation to greenhouse plots for the period of experiment due to effects of fertilizers are shown with 3 year averages.

For all $N_{150}P_{150}K_{150}$ variants of triangular combinations, $N_{150}P_{150}K_{250}$, $N_{150}Ð_{150}K_{150}$, $N_{150}K_{150}P_{250}$ and $N_{150}K_{150}P_{35o}$ variants, phosphorus potassium norms of which increased further by 100 to 200 kg, except of no fertilizer and phosphorus potassium dual $N_{150}P_{150}$, and $P_{150}K_{150}$combinations, the flowering became even in 17-20 April.

Table 1

Effect of mineral fertilizers on growth and developmental stages and their lengths for tomato plants grown in greenhouse

№	Average of 3 years	Dates			
		Flowering synchrony	Fruiting synchrony	Start of hervest	Final harvest
1	Average	20 April	4 May	8 June	8 Nov.
2	Average	19 April	29 April	7 June	8 Nov.

3	Average	17 April	25 April	5 June	8 Nov.
4	Average	17 April	25 April	5 June	8 Nov.
5	Average	17 April	25 April	5 June	8 Nov.
6	Average	23 April	2 May	12 June	8 Nov.
7	Average	19 April	1 May	7 June	8 Nov.
8	Average	19 April	28 April	7 June	8 Nov.
9	Average	20 April	28 April	7 June	8 Nov.
10	Average	25 April	5 May	14 June	8 Nov.
11	Average	27 April	5 May	16 June	8 Nov.
12	Average	25 April	5 May	14 June	10 Nov. 50

Comment: Date of seeding - the first year. 23 December
the second year. 20 December
the third year. 11 December
Planting date of seedlings - the first year. 13 March
the second year. 10 March
the third year. 2 March

Flowering synchrony of both the variants $P_{150}K_{150}N_{150}$ and $P_{150}K_{150}N_{350}$, basic norms of nitrogen in which increased by 100 to 200 kg and the variants $N_{250}P_{250}K_{250}$, basic norms of mineral fertilizer in which, increased by 100 kg was later by 5 to 10 days than the variants or between 25 and 27 April. It reveals that growth of vegetative organs of the plant is stimulated, whereas the growth of reproductive organs inhibited. Fruiting synchronized in variants $N_{150}P_{150}$, $N_{150}K_{150}$, $P_{150}K_{150}$ and $N_{150}Đ_{150}K_{150}$ of basic norms of dual and triangular combinations of mineral fertilizers and variants $P_{150}K_{150}N_{250}$, $P_{150}K_{150}N_{350}$,$N_{150}K_{150}P_{250}$, and $N_{150}K_{150}P_{350}$ basic norms of phosphorus, potassium in which increased by 100 to 200 kg between 25 April and 1 May. However, variant without fertilizer, variants $P_{150}K_{150}N_{250}$ and $P_{150}K_{150}N_{350}$, basic nitrogen norms in which increased by 100 to 200 kg, and variants $N_{250}P_{250}K_{250}$ basic norms of mineral fertilizer in which, increased by 100 kg, fruiting synchrony was later by 5 to 10 days or occurred in 5-6 May. Plant harvest of variants $N_{150}P_{150}$, $P_{150}K_{150}$ and $N_{150}Đ_{150}K_{150}$ of basic norms of dual and triangular combinations of mineral fertilizers, variants $N_{150}P_{150}K_{250}$, $N_{150}P_{150}K_{350}$, $N_{150}K_{150}P_{250}$, and $N_{150}K_{150}Đ_{350}$ phosphorus, potassium basic norms of other than nitrogen and potassium combinations in which increased by 100 to 200 kg, as well as, variants without fertilizers started simultaneously from 5 to 7 June. However, harvest of variants $P_{150}K_{150}N_{250}$, and $P_{150}K_{150}N_{350}$ basic nitrogen norms of which increased by 100 to 200 kg and variants $N_{250}P_{250}K_{250}$, basic norms of triangular mineral fertilizers in which increased by 100 kg, was also later by 7 to 10 days or between 14 and 16 June.

Because, potential of plants to produce finsihed Generally in the first decade of November, final harvest was done in all variants with or without fertilizers for the same period of time.

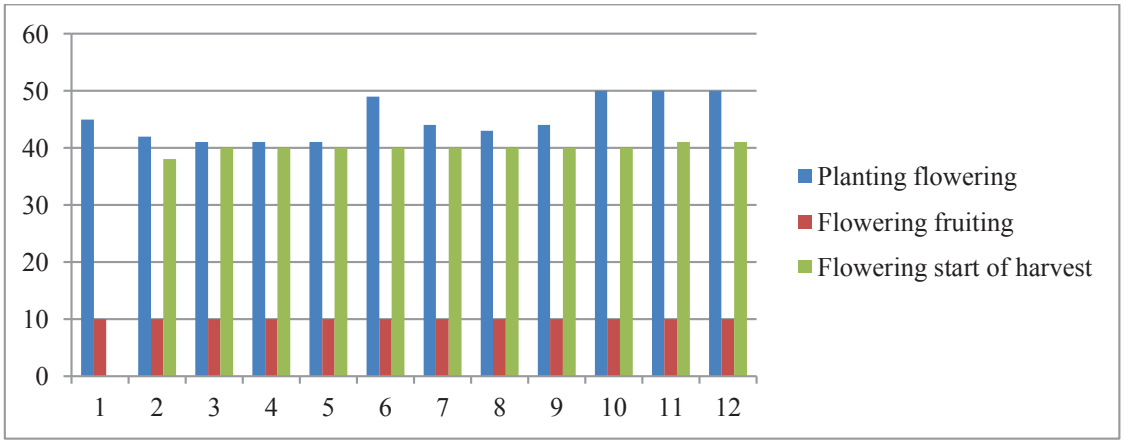

Figure 1. Effect of mineral fertilizers on the duration of growth and developmental stages of tomato grown in greenhouse

Impacts of mineral fertilizers on the length of stages of above mentioned growth stages are as follows:

In no fertilizer variant, the term between seedlings planting to flowering synchrony lasts 45 days. The length in variants $N_{150}P_{150}K_{150}$ of basic norm of dual (except of NP) and triangular combinations, and variants $N_{150}P_{150}K_{250}$, $N_{150}P_{150}K_{350}$, $N_{150}K_{150}P_{250}$ and $N_{15O}K_{150}P_{350}$, norms of phosphorus and potassium increased further by 100 to 200 kg, was 41 to 44 days, but it was 49 days or longer by 4 to 9 days in variants $N_{150}K_{150}$, variants $P_{150}K_{150}N_{250}$/ $P_{150}K_{150}N_{250}$, basic norms nitrogen in which increased by 100 kg, and $N_{250}P_{250}\hat{E}_{250}$, basic norms of triangular mineral fertilizers of which increased by 100 kg, as compared to above variants. This length lasted 41 days in variants $N_{150}P_{150}K_{250}$ and $N_{150}P_{150}K_{350}$, basic norms of triangular combination and only potassium basic norms in which increased by 100 to 200 kg, was longer by 4 days than no fertilzer variant, and shorter by 2 or 3 days than other variants. Above demonstrated that optimal triangular combination of nitrogen, phosphorus and potassium $N_{150}P_{150}K_{250}$ accelerated flowering. Lengths of the stages in the years differ with 1 or 2 days.

The length between flowering and fruiting synchronies in all variants with and without fertilizers was the same or lasted 10 days. The difference of the lengths with the years was a day, In other words, combiantions and doses of mineral fertilizers have no effects on the length from flowering to fruiting synchrony.

The length from fruiting to harvesting lasted 40 or 41 days in all variants both using or not using fertilizers. The term was 38 days or shorter by 2 or 3 days in only $N_{150}P_{150}$ variant. Between the years of research, difference was 1 to 5 days. In the third year, the length in all variants ranged between 42 and 44 days or longer by 4 to 6 days than remaininf years. It reveals mineral fertilizer has no significant effects on the length between fruiting to harvest start, but it depends from lightning and heating procedures in the year.

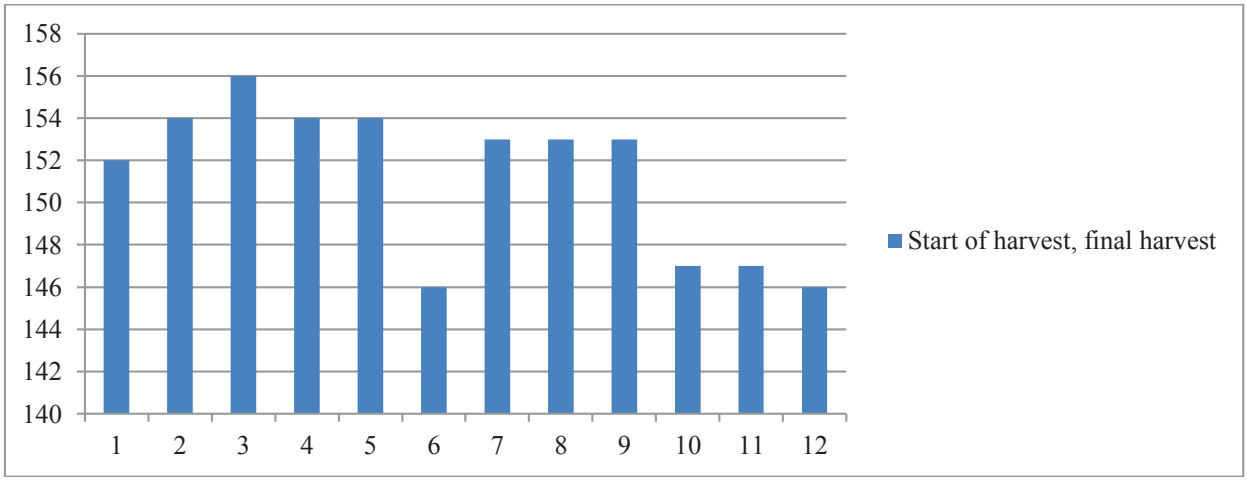

Figure 2. Relationship between the duration of harvesting of greenhouse tomato and the doses of fertilizers

Length for harvesting the plant ranged from 152 to 154 days in majority of variants of triangular combinations other than not fertilzed and dual $N_{150}K_{150}$ mineral fertilizer variant. Fruiting length was 146 or 147 days or shortened by 6 or 7 days in the variant $N_{150}K_{150}$, and the variants $P_{250}K_{250}N_{250}$ and $P_{250}K_{250}N_{350}$, nitrogen norms of triangular combinations of which increased by 100 to 200 kg. It is directly associated with the start of harvests of these variants later by 7 to 11 days than remaining variants.

Effects of mineral fertilizers on some biometrical parameters of greenhouse tomato

General patterns of growth and development, and size of any plants exert special effects on the fate of plant production. Growth of main stem, distance between the tassels, numbers and weigths of flowers and fruits play critical roles in plant production.

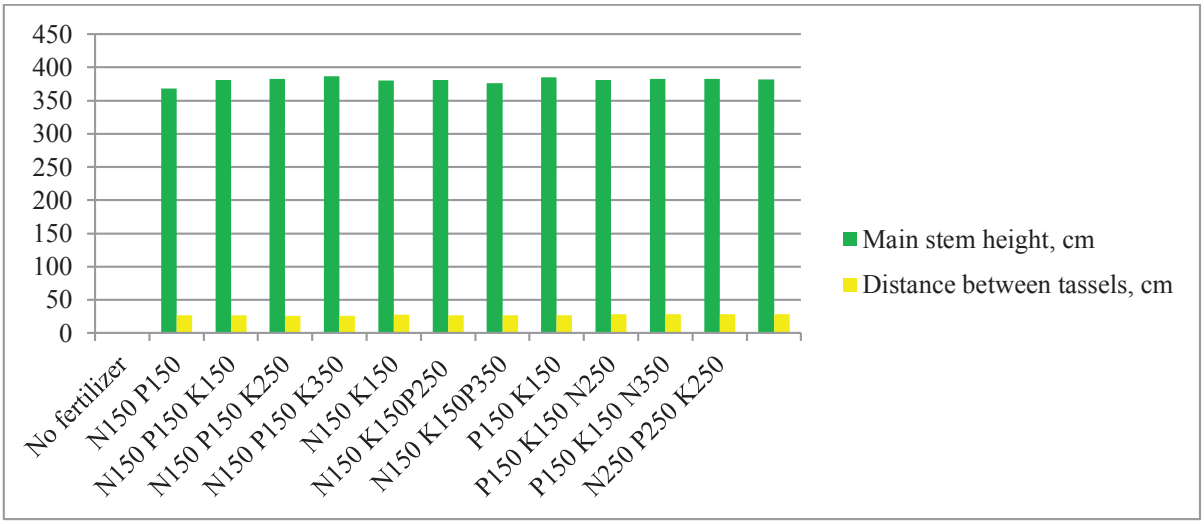

Figure 3. Effect of mineral fertilizers on the height of plant and distance between tassels of green house tomato

Results of the study on patterns of main stem growth of tomato plant show height of main stem in no fertilzer and $N_{150}P_{150}$ variants was 368 cm and 381 cm respectively, while it was 387 cm high for $N_{150}P_{150}K_{250}$ variant or the higher than the remaining variants. As compared to control plants, it was higher by 19 cm.

Because the number of tassels and fruits per plant depends from the distance between the tassels localized on the main stem of tomato, it is an essential parameter. Distance between tassels is 26.0 cm in the variants $N_{150}P_{150}K_{150}$ and $N_{250}P_{250}K_{250}$ and it is shorter by 0.7 cm than control plants and 1.0 to 2.0 cm than other variants with higher doses of fertilizers.

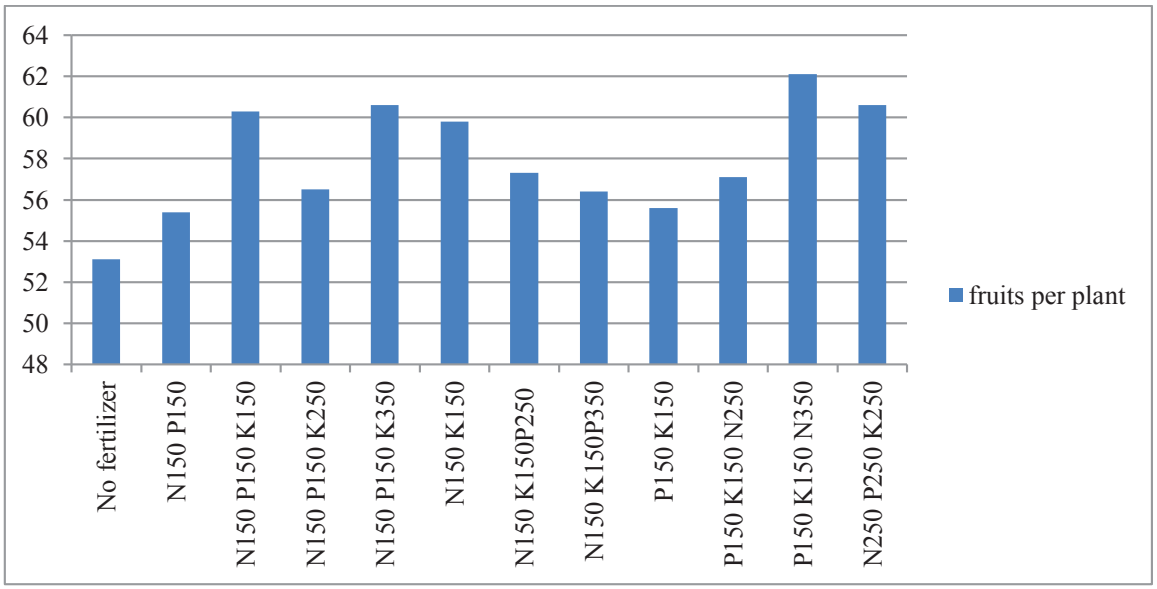

Figure 4. Effect of mineral fertilizers on the counts of fruits per plant of greenhouse tomato

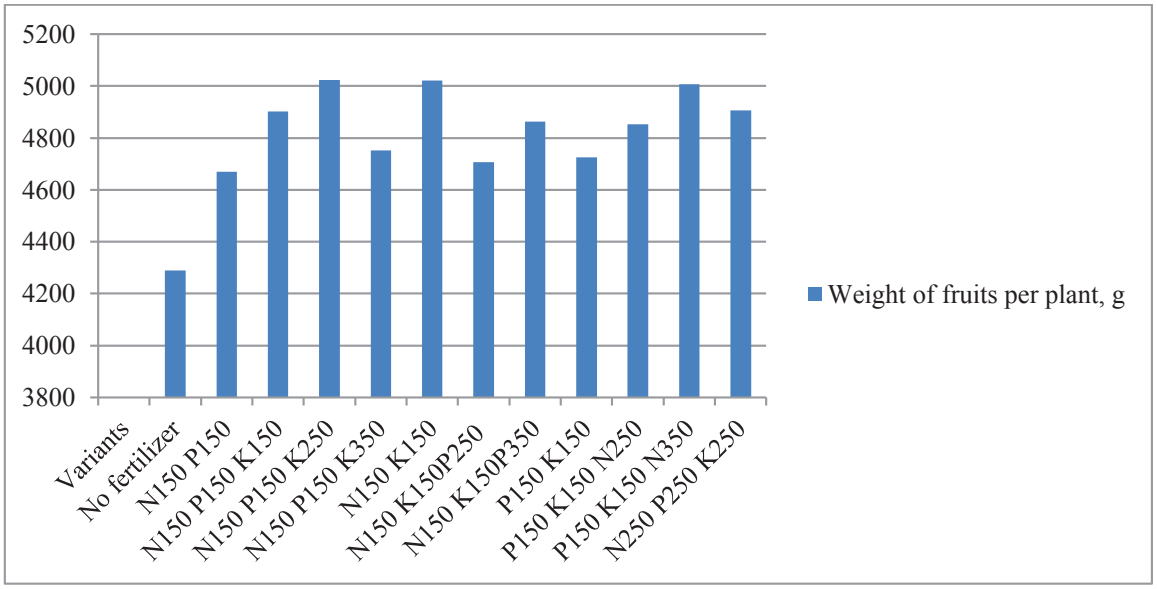

Figure 5. Weight of green house tomato plant fruit, g

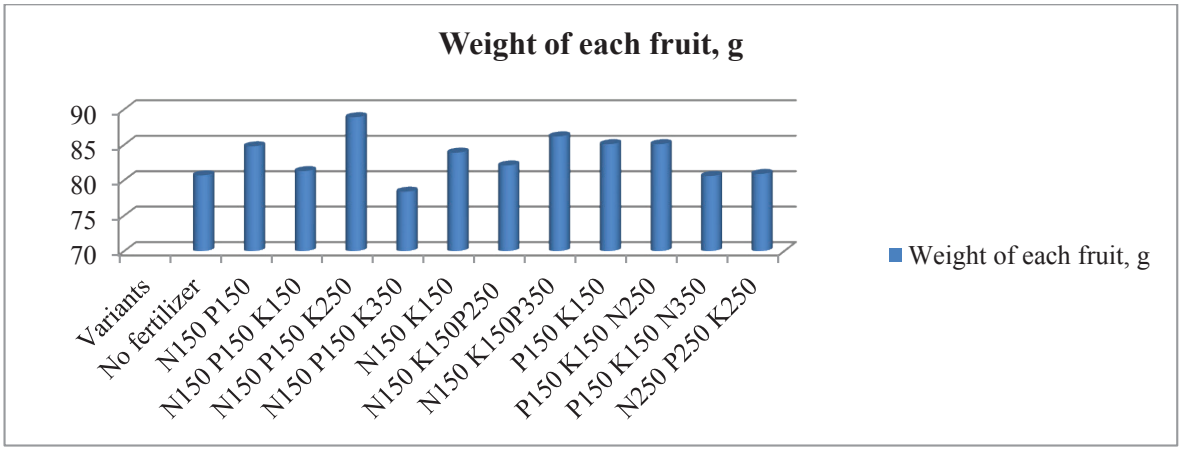

Figure 6. Effect of mineral fertilizer on the weight of each fruit of greenhouse tomato

The number and weight of fruits per tomato plant and weight of each fruit vary with doses of fertilizers. The number of fruits is the lowest or 53.1, weight of a fruit is 80.7 g and weight of fruits per plant is 4289.4 g in control variant, while the number of fruits increases to 60.3, weight of a fruit is 81.3 g and weight of fruits per plant is 4902.9 g in $N_{150}P_{150}K_{150}$ variant. For the variant $N_{150}P_{150}K_{250}$, which as the highest production rate, the number of fruits per plant dropped to 56.5, each fruit weighed 88.9 g and total weight of fruits per plant was 5022.8 g. All these demonstrate the distance between the tassels exert significant effect on the settlement of fruits of plant due to variable effects of fertilizers doses on the height of main stem.

DISCUSSION

According to results of our study, optimal norm of triangular combination of nitrogen, phosphorus and potassium $N_{150}P_{150}K_{250}$ accelerated the flowering. The duration of this stage differed with 1 or 2 days in the years. Tomato used potassium at highest rate, then nitrogen at second and then calcium, phosphorus and magnesium. Majority of nutrients are absorbed in growing younger parts of the root. In this period, the fibers of root hair function very actively. Nutrients are carried to root system in the form of anions and cations. Nitrogen is absorbed in the form of nitrate NO_3 anion and NH_4 cation, sulfur in the form of SO_4 anion, and the plant absorbs phsophorus in the form of phosphoric acid anion P_2O_5. It is in agreement with the results of other authors that

potassium, calcium, magnesium, copper, iron and zinc are absorbed in the form of cation [2].
Depending on the conditions of planting the tomato, the plants absorb 4,0-4,6 g/kg nitrogen, 0,96-1,4 g/kg $P_2 0_5$, 4,0-9,7 g/kg $K_2 0$, 1,8-4,6 g/kg CaO, and 0,7-0,78 g/kg KdO [1, 2].
According to the study performed by Merkulov (1987), N:K ratio between planting and fruiting of tomato is 1:3, while it is 1:2 and 1:1.5 at the final stage of growth [3]. It is important to use more nitrogen fertilizer during flowering and fruiting stages. When fruits are completely ripened, it is proper to increase dose of potassium fertilizer [6,7,8, 9].
Under condition of greenhouse soil for the present study, increase of potassium norm in complete mineral fertilizer ($N_{150}P_{150}K_{250}$) to 250 kg resulted in the leveation of production to 20.2 kg and it is in agreement with the studies by other authors revealing tomato absorbs potassium at the highest rate.

CONCLUSION

1. Increased dose of nitrogen results in intensification of green mass growth and prolongation of growth lengths , but decrease of percentage of fruits in total biomass of the plant. At optimal dose of fertilizer $N_{150}P_{150}K_{250}$, distance between tassels of the plant shortens to 26 cm and the maximal height of the plant reached 387 cm.
2. Effect of mineral fertilizer on the length of growth and developmental stages is that flowerinf synchrony is later by 5 to 10 days in the variants $P_{150}K_{150}N_{150}$ and $P_{150}K_{150}N_{350}$, in which basic norm of nitrogen increased by 100 to 200 kg, and the variant $N_{250}P_{250}K_{250}$, in which basic norms of triangular mineral fertilizer increased by 100 kg. It reveals greater nitrogen supply caused stimulation of vegetative organs growth and inhibition of reproductive organs.

REFERENCES

1. Bekseev N.V., Growing early tomato. L.Agropromizdat. 1989. p 272.
2. Vashenko S.F., Chekunova Z.I., Savinova N.I et al. Vegetable production on protected soil. M. Kolos. 1984. p 272.
3. Vendillo G.G., Mikanaev T.A., Petrichenko V.N., Skarjinskii A.A. Fertilizer of vegetable cultivation. M. Agropromizdat: 1986. p 206.
4. Bolooj D. Results of the study on planting vegetables on protected soil. Publ. PCPRI. 1975. № 3 . p 34.
5. Geissler T., Geyer B. Structure of greenhouse soil protected soil. Dissertation for ScD in Agricultural sciences, M. 1991. p 351.
7. Jurbitskii Z.I. Physiological features of mineral nutrition of vegetable plants as a basis of rational use of fertilizers.Autoreferate of dissertation for ScD degree in Biology. M. 1949. p 26.
8. Magnitskii K.P. Diagnosis of demand of fertilizers for plants. M.: Moskowskii rabochy, 1972.
9. Adams P., Massey D.M. Nutrient uptake by tomatoes from recirculating solutions. 6-th intern. Cong. On Soilless culture. Wageningen.