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Studies on the effect of different plant growth regulators on growth and yield attributes of tomato (*Solanum lycopersicum* L.) CV. Kashi Amrit

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Abstract

The present investigation was undertaken to “studies on the effect of different plant growth regulators on growth and yield attributes of tomato (*Solanum lycopersicum* L.) cv. Kashi Amrit” Horticulture cum instructional farm in the Experimental field of AICRP on vegetable crops, College of Agriculture, IGKV, Raipur (C.G), during 2018-19. The experiment was laid out in Completely Randomized Design having often treatment and three replication. All growth, phenological as well as yield and quality parameters was found to be significantly superior at different concentration of GA₃, NAA and Kinetin as compare to control treatment. The data clearly showed that the maximum plant height (84.54cm), number of leaves per plant (35.67), number of branches in per plant (16.34), plant girth (4.64cm) at 90 days after transplanting, minimum days required to first flowering (25.67), days to first fruiting (32.34) and minimum days to maturity (63.33), maximum no. of fruits per plant (52.67), average fruit weight(1500g), fruit length(4.96cm), fruit diameter(5.16cm), yield per plot(33kg), yield per ha.(555.55qt) was reported in treatment where plant has been sprayed with GA₃ (50ppm).

Keywords: Tomato, plant growth regulators, growth, yield parameters

Introduction

Tomato (*Solanum lycopersicon* L.) is an important vegetable crop belonging to the family Solanaceae, which has tremendous popularity during the last century. It is a tropical day and a certain percentage of cross-pollinated also occurs. The crop is native to Central and South America (Vavilov, 1951). In a natural manner, it lives more than two years but can be cultivated as an annual crop. Because of having an immense economic and advantages it is cultivated widely. Moreover, tomato is considered as the second greatest consequential vegetable crop in the world after potato. A top the last century, tomato [*Lycopersicon esculentum* Mill.] as an important vegetable crop, has attained massive popularity. When we make use of plant growth regulator in tomato has been found valuable for growth, yield, quality, earliness, and cold, high-temperature fruits setting and to build up resistance to TLCV. Soaking of seed earlier than sowing in GA₃ (0.5ppm) or 2,4-D (0.5ppm) enhances the germination of seed. Plant growth regulators (PGR's) are used widely in crop production to improve plant growth and yield by increasing fruit set, fruit no. and weight (Batlang, 2008) [2]. They play important roles in the enlargement of tomato fruit (Srivastava and Handa, 2005). Use of plant growth regulators had enhanced the production of tomato and other vegetables in reverence of better growth and yield (Saha, 2009). Auxins are recognized to affect parthenocarpic, fruit setting and fruit size (Matlob and Kelly, 1975) [9].

The key important hormone is auxin produced by plants is indole-3-acetic acid (IAA). GA₃ is one of the remarkable growth-stimulating hormones and cell division and cell elongation thus it helps in the growth and development of plants. GA₃ increases leave size, stem lengths and fruit sets (Serrani *et al.*, 2007). Cytokinins (CKs) are vital plant hormones that are known to be key regulators of various aspects of plant growth and development, including cell division, leaves senescence, lateral stem and root conformation, stress tolerance and nutritional signalling (Argueso *et al.*, 2009) [1]. Keeping the above circumstance in view, the present study is for estimation of the performance of GA₃, NAA, Kinetin on Growth and yield in tomato. Plant growth regulators are a chemical substance with small concentration; they stimulate and

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Regulate the physiological process of the plant. Mostly applied growth regulators is, GA₁, NAA, 4 - CPA, 2, 4-D. It should be applied in less quantity; they are equally efficient and profit-making to the farmer. However, the improvement of the crop differs greatly depending on the type of growth regulators used, concentration, time and application.

Material and Methods

A field experiment to “studies on the effect of different plant growth regulators on growth and yield attributes of tomato (*Solanum lycopersicum* L.) Cv. Kashi Amrit” was conducted at Research cum Instruction Farm, Department of vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, and Raipur (C.G.) during the Kharif season of 2018-19.

The experiment consisting ten treatments in Randomized Block Design with three replication with 2×1.8 meter plot size and spacing of plant is 60cm×45cm (R×P). Treatment consist of different levels of GA₃ (25, 50 and 75ppm), NAA (15, 20 and 25ppm) and Kinetin (25, 50 and 75ppm) along with control. The treatment consisted of ten treatments viz., T₁-control (water spray), T₂-GA₃@25ppm, T₃-GA₃@50ppm, T₄-GA₃@75ppm, T₅-NAA@15ppm, T₆-NAA@20ppm, T₇-NAA@25ppm, T₈-Kinetin@25ppm, T₉-Kinetin@50ppm, T₁₀-Kinetin@75ppm. These different concentrations of GA₃, NAA and Kinetin were sprayed on the crop. The first foliar application was done at 30 days after planting in the morning hours. The second application at 45 days and the third application at 60 days after planting were done after the wetting agent. The uniform spraying was carried out with the help of the knapsack sprayer, the leaves on both sides were completely wet with the spray solution. The total amount of solution required to be sprayed on experimental plants was decided by representative tomato plants.

Result and Discussion

The data on vegetative growth parameters viz. Plant height(cm), number of leaves per plant, number of branches per plant, plant girth, days to first flowering, days to first fruiting, days to maturity and yield attributes of tomato. This was significantly influenced by the different type of plant

growth regulators. Were the data of growth parameter is presented in tables.

Plant height (cm) during the experiment observation for plant height were recorded which shown significant result in plant height at 30,45,60,and 90 days after transplanting in treated plots as compare to untreated one (i.e. control). The highest plant height was recorded during harvesting by the treatment T₃ (84.54cm) while that of T₁- should be control showed plant height (73.97cm). All nine treatments, showed superior plant height over control plants (Table 1; Fig 1).

Number of leaves: the experiment for plant height were recorded which shown significant differences in number of leaves per plant among all treatments. The number of leaves were highly recorded by the treatment T₃ (35.67) whereas control plants recorded number of leaves 25.67 per plant. The numbers of leaves were ranging from 25.67 to 35.67 per plant (Table 2; Fig 2).

No. of branch in per plant: The different treatment of PGR's showed variation in results in no. of branch in per plant of tomato. The branch was recorded during harvesting by treatments T₃ (16.34) while that of control showed no. of branch in per plant 12.67, this may be due to the role of GA₃ in increasing cell division and cell elongation. Same finding has been reported by Prasad *et al.*, (2013) [11], Kumar *et al.*, (2014) [8] and Chauhan *et al.*, (2017) [4].

Plant girth (cm) all nine treatments showed increased plant girth than control. The maximum plant girth showed by treatment T₃ (4.64cm) while T₁-control plants recorded plant girth 4.27cm (Table 3; Fig 3). Minimum days taken to first flowering, first fruiting and days to maturity all the nine treatments of PGR showing namely T₃ (25.67), showed early flowering, early fruiting T₃ (32.34), and taken minimum days to maturity T₃ (63.33) than the control while T₁-control plants recorded first flowering 32.34, days to first fruiting (38.67) and maturity is recorded (76.96) days. (Table 4; Fig 4) Treatment T₂ (GA₃@ 50ppm) was found to be statistically superior than all other treatment, this may be due to the role of this growth stimulating hormones to complete the shortage of natural growth substances require for cell division and cell elongation. The present finding also agreed to the result of Bhalekar *et al.*, (2006), Rahman *et al.*, (2015) [12].

Table 1: Effect of plant growth regulator on plant height at 30, 45, 60 and 90 days after transplanting in tomato cultivar ‘Kashi Amrit’ under field condition

1. Plant height (cm.)				
Treatments	30Days	45Days	60Days	90Days
T ₁ (Control)	37.34	47.34	62.67	73.97
T ₂ (GA ₃ @25ppm)	45.64	55.67	67.34	78.16
T ₃ (GA@50ppm)	58.67	69.34	71.34	84.54
T ₄ (GA@75ppm)	44.67	54.67	66.34	77.82
T ₅ (NAA@15ppm)	41.67	52.34	64.67	76.27
T ₆ (NAA@20ppm)	44.34	59.67	66.67	77.85
T ₇ (NAA@25ppm)	44.67	56.34	65.67	75.86
T ₈ (Kinetin@25ppm)	41.67	52.67	64.67	80.18
T ₉ (Kinetin@50ppm)	40.67	52.67	66.34	77.78
T ₁₀ (Kinetin@75ppm)	41.34	53.34	66.34	79.69
CV (%)	10.98	8.54	7.07	7.35
CD (0.05)	8.59	8.40	8.31	10.24

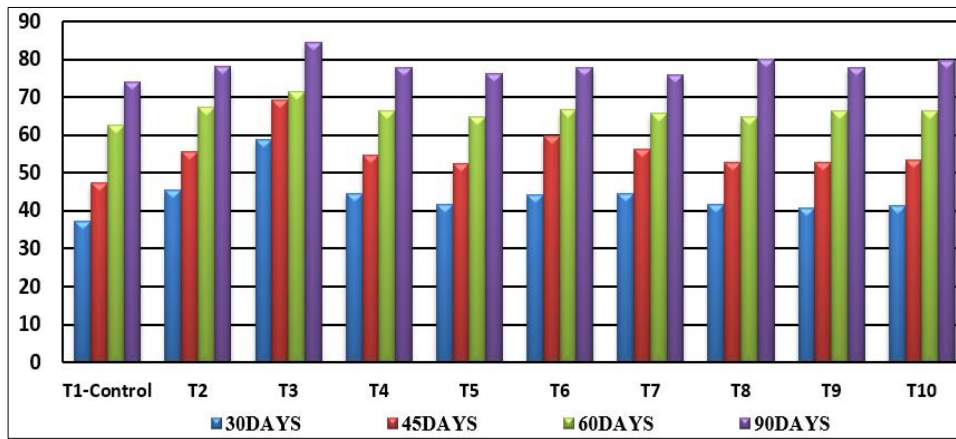


Fig 1: Effect of different types of plant growth regulator on plant height of tomato cultivar 'Kashi Amrit' at successive growth stage

Table 2: Effect of plant growth regulator on no. of leaves per plant at 30, 45, 60 and 90 days after transplanting in tomato cultivar 'Kashi Amrit' under field condition

2. No. of leaves per plant				
Treatments	30Days	45Days	60Days	90Days
T ₁ (Control)	6.67	21.67	23.67	25.67
T ₂ (GA ₃ @25ppm)	7.34	26.67	27.34	29.34
T ₃ (GA@50ppm)	9.34	29.67	33.34	35.67
T ₄ (GA@75ppm)	7.67	26.67	27.34	29.67
T ₅ (NAA@15ppm)	6.34	26.34	27.67	29.34
T ₆ (NAA@20ppm)	7.34	26.67	27.34	28.67
T ₇ (NAA@25ppm)	7.34	26.67	27.67	30.34
T ₈ (Kinetin@25ppm)	8.34	29.67	29.67	31.67
T ₉ (Kinetin@50ppm)	7.34	26.34	27.34	30.34
T ₁₀ (Kinetin@75ppm)	7.35	25.35	26.67	28.67
CV (%)	8.81	7.75	8.91	7.67
CD(0.05)	1.17	3.67	4.40	10.57

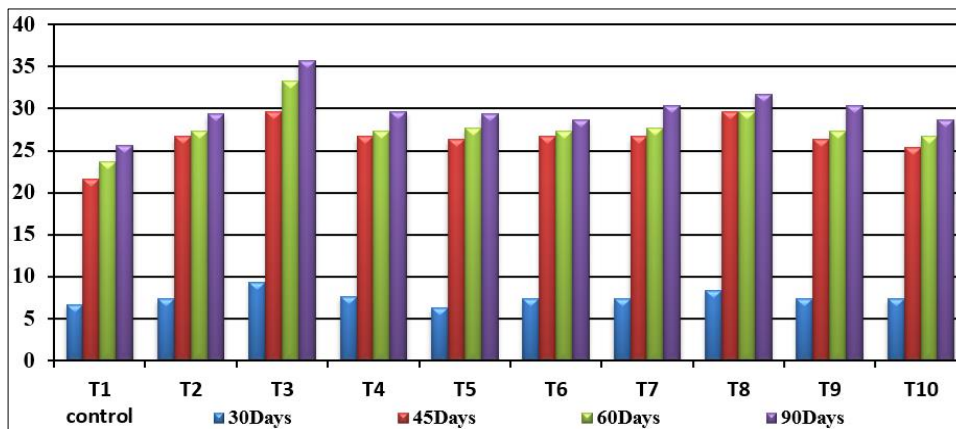


Fig 2: Effect of different types of plant growth regulator on no. of leaves per plant of tomato cultivar 'Kashi Amrit' at successive growth stage

Table 3: Effect of plant growth regulator on no. of branches per plant at 30, 45, 60 and 90 days after transplanting in tomato cultivar 'Kashi Amrit' under field condition

3. No. of branches per plant				
Treatments	30Days	45Days	60Days	90Days
T ₁ (Control)	5.00	10.34	10.34	12.67
T ₂ (GA ₃ @25ppm)	6.00	11.67	12.34	14.34
T ₃ (GA@50ppm)	7.60	14.11	14.34	16.34
T ₄ (GA@75ppm)	6.00	12.67	12.67	14.34
T ₅ (NAA@15ppm)	6.60	12.34	11.67	14.34
T ₆ (NAA@20ppm)	6.60	11.34	11.34	14.34
T ₇ (NAA@25ppm)	7.00	11.34	12.34	15.34
T ₈ (Kinetin@25ppm)	6.60	11.67	12.34	14.34
T ₉ (Kinetin@50ppm)	6.00	11.34	11.67	15.67
T ₁₀ (Kinetin@75ppm)	6.60	12.34	11.67	14.34
CV (%)	8.08	8.31	8.33	8.43
CD(0.05)	0.92	1.76	1.79	2.19

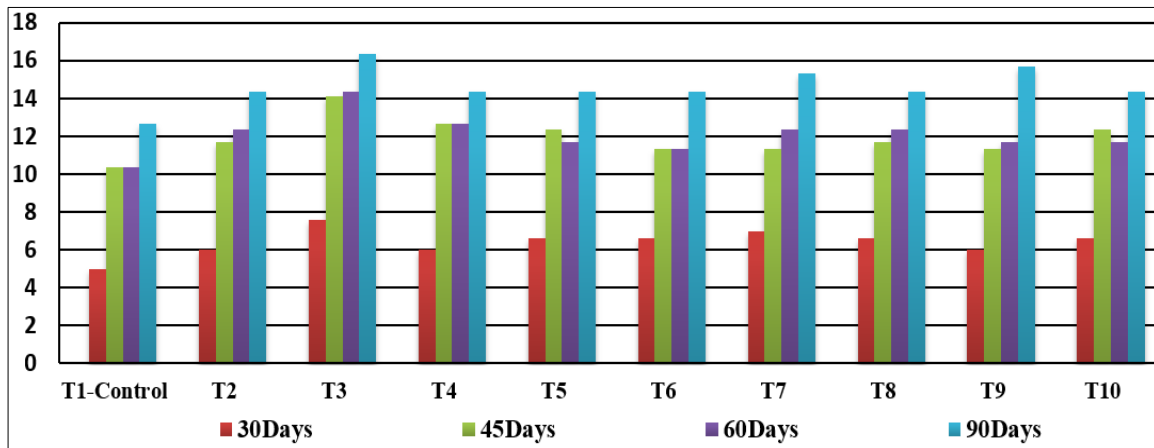


Fig 3: Effect of different types of plant growth regulator on no. of branch per plant of tomato cultivar ‘Kashi Amrit’ at successive growth stage

Table 4: Effect of plant growth regulator on plant girth at 30, 45, 60 and 90 days after transplanting in tomato cultivar ‘Kashi Amrit’ under field condition

4. Plant girth (cm.)				
Treatments	30 Days	45 Days	60 Days	90 Days
T ₁ (Control)	3.24	3.77	4.13	4.27
T ₂ (GA ₃ @25ppm)	4.03	3.97	4.26	4.37
T ₃ (GA@50ppm)	4.43	4.34	4.54	4.64
T ₄ (GA@75ppm)	3.67	4.03	4.24	4.37
T ₅ (NAA@15ppm)	3.93	4.26	4.24	4.44
T ₆ (NAA@20ppm)	3.96	4.03	4.04	4.34
T ₇ (NAA@25ppm)	4.03	4.23	4.27	4.44
T ₈ (Kinetin@25ppm)	4.06	4.03	4.17	4.34
T ₉ (Kinetin@50ppm)	3.93	4.06	4.24	4.37
T ₁₀ (Kinetin@75ppm)	4.13	3.93	4.27	4.44
CV (%)	8.47	7.80	8.47	8.04
CD (0.05)	0.60	0.56	0.64	0.63

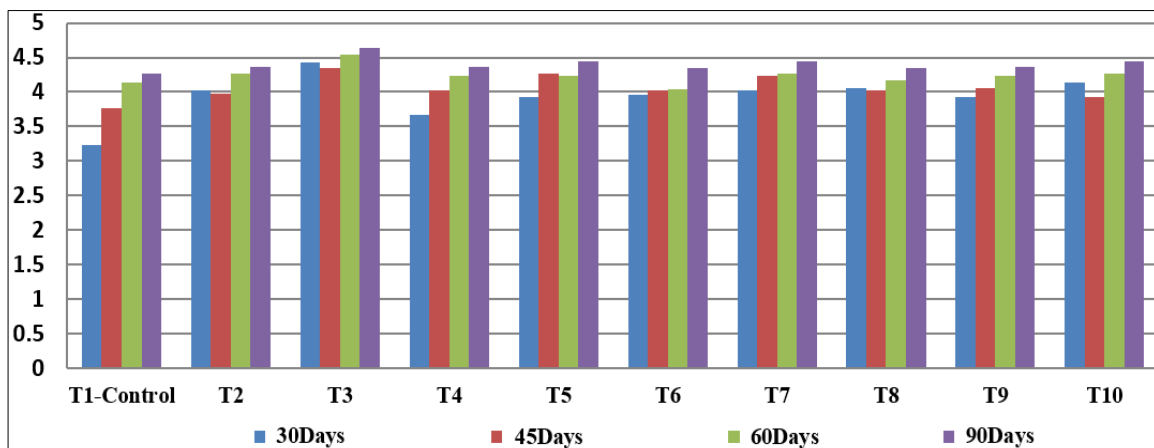


Fig 4: Effect of different types of plant growth regulator on Plant girth plant of tomato cultivar ‘Kashi Amrit’ at successive growth stage

Table 5: Effect of plant growth regulator on days to first flowering, days to first fruiting, days to maturity after transplanting in tomato cultivar ‘Kashi Amrit’ under field condition

Treatments	Days to first flowering	Days to first fruiting	Days to maturity
T ₁ (Control)	32.34	38.67	76.96
T ₂ (GA ₃ @25ppm)	28.34	33.34	68.25
T ₃ (GA@50ppm)	26.67	32.34	63.33
T ₄ (GA@75ppm)	28.34	34.34	65.28
T ₅ (NAA@15ppm)	28.67	34.34	67.75
T ₆ (NAA@20ppm)	25.67	34.34	68.62
T ₇ (NAA@25ppm)	28.67	33.67	68.58
T ₈ (Kinetin@25ppm)	27.34	34.34	69.39
T ₉ (Kinetin@50ppm)	28.34	35.34	69.41
T ₁₀ (Kinetin@75ppm)	27.67	33.67	70.38
CV (%)	9.28	7.89	8.94
CD (0.05)	4.65	4.83	10.92

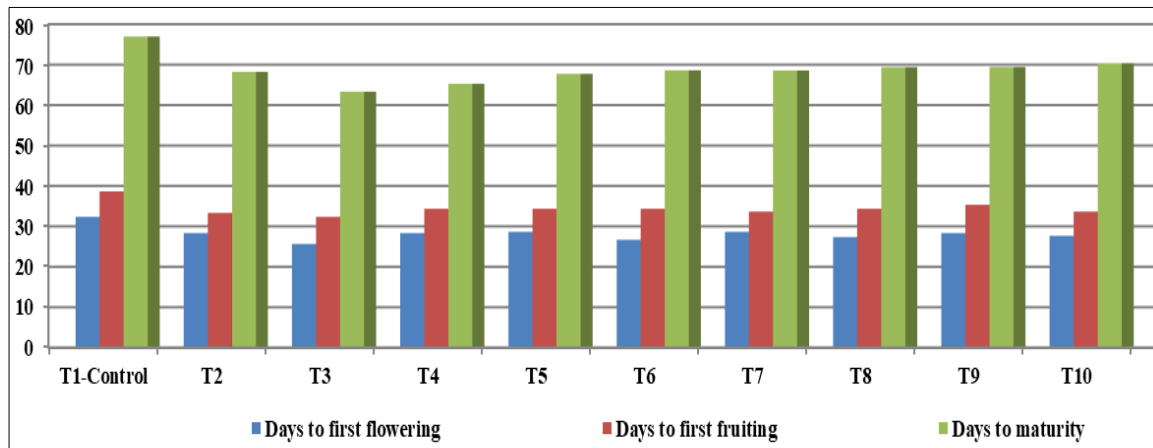


Fig 5: Effect of different types of plant growth regulator on days to first flowering, days to first fruiting, days to maturity plant of tomato cultivar 'Kashi Amrit' at successive growth stage

In yield attributes, the data accessible on no. of fruits in per plant of tomato influenced by different plant growth regulators. The no. of fruits in per plant varied from 38.34 to 52.67. The maximum no. of fruits recorded in T3 (52.67), they treatment showed maximum fruiting than controlled treatments (Table 5: Fig5). Average fruit weight (g) all the nine treatments are influenced by different PGR's. The average fruit weights are increases from 600(g) to 1500(g). The maximum average fruit weight recorded in T3 (1500g), they treatment showed maximum average fruit weight than control treatment showed 600g (Table 5). Fruit length (cm.) all the nine treatments of PGR, in decreasing order T3 (4.93 cm), showed superior fruit length over control while T1-control plants showed fruit length 4.06 cm (Table 5). Fruit diameter (cm.) the fruit diameter recorded for all nine

treatments and untreated control which were ranging from 4.03 to 5.16 cm. The treatment T3 recorded highest fruit diameter while T1-control plants showed fruit diameter 4.03 cm. All the treatments showed superior fruit diameter than T1-control (Table 5)

Yield (kg/plot) the per plot fruit yield recorded by all nine treatments and untreated control was ranging from 13.2 to 33.0 kg per plot. The treatment T3 recorded highest per plot yield 33.0 kg whereas T1-control plants showed fruit weight 13.2 kg. All the treatments showed superior per plot fruit yield than T1-control (Table 5). Yield (qt/ha) where the fruit yield per hectare in quintals was varying from 222.23 to 555.55, the highest fruit yield recorded by treatment T3 (555.55 qt) while that of T1-control showed fruit yield 150.37 quintals. (Table 5).

Table 5: Effect of plant growth regulator on yield attributes of tomato cultivar 'Kashi Amrit' under field condition

Treatments	No. of fruits per plant	Average fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Yield per plot (kg)	Yield (ha/qt)
T ₁ (Control)	38.34	600	4.06	4.03	13.2	222.23
T ₂ (GA ₃ @25ppm)	43.34	1200	4.36	4.36	26.4	444.44
T ₃ (GA@50ppm)	52.67	1500	4.93	5.16	33	555.55
T ₄ (GA@75ppm)	46.67	1450	4.66	4.36	31	537.037
T ₅ (NAA@15ppm)	46.67	850	4.33	4.53	18.7	314.81
T ₆ (NAA@20ppm)	47.34	900	4.33	4.43	19.8	333.34
T ₇ (NAA@25ppm)	48.67	1000	4.53	4.53	22	370.37
T ₈ (Kinetin @25ppm)	50.34	750	4.23	4.43	16	277.78
T ₉ (Kinetin @50ppm)	45.34	800	4.36	4.53	17.6	296.29
T ₁₀ (Kinetin @75ppm)	45.34	960	4.16	4.46	21.12	355.55
CV (%)	8.30	9.22	8.07	8.19	9.20	9.20
CD (0.05)	6.84	163.54	0.63	0.65	3.57	60.57

Conclusion

The application of plant growth regulators are effective response in growth and yield attributes of tomato. The finding revealed that treatment T₃-@GA₃50ppm recorded the maximum (plant height (cm), number of leaves per plant, number of branches per plant, plant girth (cm) and minimum days taken in (days to first flowering, days to first fruiting, days to maturity) and maximum in yield parameters are no. of fruits per plant, fruit length, fruit diameter, yield per plot (kg), yield (ha/qt).

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