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Effects of MM. 106 and M. 26 Rootstocks on Agromorphological Characteristics of 'Crispin' and 'Granny Smith' Apple Cultivars in Chencha, Southern Ethiopia.

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Abstract: *This study investigated the different size determining rootstocks (MM.106 and M.26) reactions with two different apple cultivars (Crispin and Granny Smith) and their effect on vegetative growth in Chencha, Southern Ethiopia. The used research design was a complete randomized block design in three replicates. Features measured during the design included: plant height, trunk growth, inter-node length, canopy width and number of branches. Results showed that, Crispin on MM.106 rootstock had the most mean shoot length current year (34.28 cm), tree height (112.24 cm), trunk cross sectional (19.78 cm^2) and number of branches (8) compared to Granny Smith (23.19cm), (87cm), (11.12 cm^2) and (6) respectively. The shoot growth of Crispin on M.26 (18.36cm), height (78.26cm), trunk cross sectional area (9.42 cm^2) and branch (4) in comparison to Granny Smith (14.06cm), (62.67cm) (7.26cm^2) and (3) respectively was also high. The most inter-node length current year was recorded for Crispin on MM.106 (2.98cm), on M.26 (0.67) while Granny Smith on both MM.106 and M.26 recorded least (1.64cm) and (0.47cm) respectively. Similarly the most canopy width cultivar was registered for Crispin on MM.106 (98.24cm) on M.26 (47.12cm) whereas Granny Smith (65. 64 cm) and (41.45 cm) was the least. This study showed that, all vegetative growth parameters was higher on MM.106 than on M.26. On basis of the results, among experimented rootstocks and cultivars, Crispin on MM.106 rootstock is the proper compound to achieve the largest vegetative growth under the naturally occurring low soil pH (4.8) of Chencha (tolola) district.*

Keywords: *Dwarf and semi-dwarf rootstock, Apple cultivars, Vegetative growth, Chencha*

I. Introduction

Rootstocks can influence the vigour, habit and cropping of the scion cultivar, as well as its resistance/tolerance to soil or aerial borne pests and diseases and to unfavourable climatic or edaphic conditions{13}. Most modern fruit growers, who are producing fruits to be handpicked for the fresh market, are seeking trees with limited height to facilitate harvesting, pruning and thinning operations by reducing the use of ladders and or steps . Smaller trees are also easier to target with sprays, so reducing undesirable spray drift and increasing efficiency of spray usage.

The rootstock has far more effect on the ultimate size of the tree than the scion cultivar {10}. Most semi-dwarfing rootstocks reduce both tree height and spread, although many may also influence the natural habit of the scion. Moreover, dwarfing rootstocks also reduce the fresh weight (mass) of the aerial parts of the tree {8}. The author further stated that, early trials conducted with apple rootstocks concluded that most of the dwarfing and semi-dwarfing of the scion was brought about by shortening of the shoot internodes. The effects were thought to be similar to those induced in scions following the use of chemical plant growth retardants, such as the gibberellins biosynthesis inhibitors (paclobutrazol, prohexadione-Ca, cyclocel and daminozide). Scions grown on dwarfing and semi-dwarfing rootstocks for apple and other tree species frequently terminate active shoot extension and form a terminal resting bud earlier in the autumn than similar trees on more invigorating rootstocks {13}. Apple rootstocks vigour can be determined destructively by measuring the dry weight of whole tree over certain period. However, a simple and reliable alternative is to measure trunk cross sectional area (TCSA) which has good relationship with tree size and weight when the trees are dormant {10}. According to {2}, rootstocks greatly affect the vigour, productivity of plants and quality of the fruit by their differences in absorption and translocation of mineral elements from soil which ultimately affect the overall performance of the plants. Rootstocks are also profoundly affect water and nutrients uptake from the soil especially nitrogen which is of prime importance as it affects the photosynthetic rate, production of carbohydrates and proteins, which in turn control plant growth and development{14}. In addition to this, it affects phosphorous and potassium absorption that has a key role in maintaining fruit quality. The present study also measured parameters of vigour, yield and fruit quality. The results of these evaluations will be discussed in future articles. The objective of this study is to evaluate the effect of size determining rootstocks on vegetative growth of apple cultivars under study.

II. Materials and Methods

2.1. Plant material, experimental design, sample collection:

This study was carried out in mostly degraded highland area of Chencha with altitude of 2700masl at experimental site of toloa district, Ethiopia. The experimental soil had a pH of 4.8 with silt clay in texture having 14% Sand, 43 % Silt, and Clay 43%. The experiment was done on three year old apple cultivars consist of Crispin and Granny Smith grafted on semi-dwarf MM.106 and dwarf M.26 rootstock. The trees were planted in 2014 in three repeat at a distance of 3 x 2 m. Fifteen representative trees within each replication and then four uniform branches in the cardinal points of each tree were selected for sampling and data collection following {7} method. The randomized complete block (RCBD) design with three replications was used for statistical analysis.

2.2. Agromorphological characteristics:

For data on shoot growth, average current season growth of four branches in each tree in late of seasonal growth was recorded in cm. The average length of current seasonal internodes was measured in middle of each branch in cm following {7} method and also the total number of branches were counted. Trunk circumference was measured on each tree every year after leaf drop (in August under climatic condition of Ethiopia) at a premarked location 20 cm above the soil surface and converted to trunk cross sectional area (TCSA cm^2) following {15} and {7} method. For measure the tree height, distance between graft unions to end of highest branch in main trunk was recorded in cm.

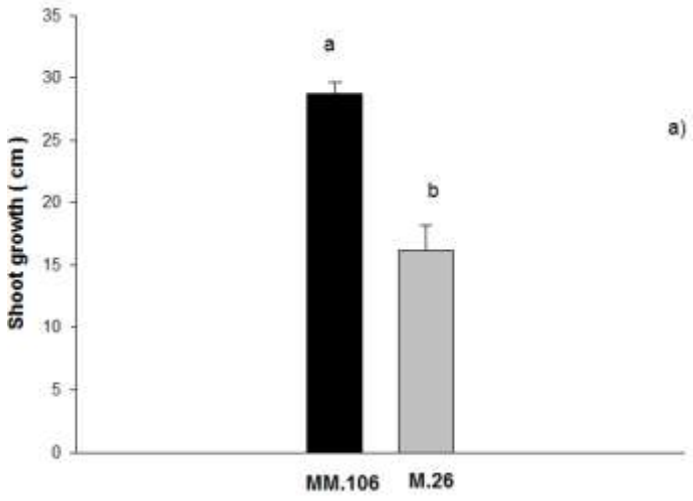
2.3.Statistical analysis

Analysis of variance (ANOVA) and mean separation was performed by Duncan's multiple range tests (DMRT) at the level of the significance (LSD at $P<0.05$) {3}). Sigma plot 10 was used to present the analyzed data in different graphs. The results were elaborated separately for each measurements value.

III. Result And Discussion

3. 1. Vegetative characteristics cultivars grafted on MM106 and M.26 rootstocks

Tree growth and development can be markedly influenced by both cultivar and rootstock (Hirst & Ferree, 1995) {5}. Previous study reported that, rootstocks have significant effect on trunk diameter, plant height, and number of branches of apple scions {11}. In this study, results showed that Crispin on MM.106 rootstock had the most mean shoot length current year (34.28 cm), tree height (112.24 cm) , trunk cross sectional (19.78 cm^2) and number of branches (8) compared to Granny Smith (23.19cm), (87cm), (11.12 cm^2) and (6) respectively. The shoot growth of Crispin on M.26 (18.36 cm), height (78.26cm), trunk cross sectional area (9.42 cm^2) and branch (5) in comparison to Granny Smith (14.06cm), (62.67cm) (7.26cm^2) and (4) respectively was also high. The most inter-node length current year was recorded for Crispin on MM.106 (2. 98cm) followed on M.26 (0.67) while Granny Smith on both MM.106 and M.26 recorded least (1.64cm) and (0.47cm) respectively. Similarly the most canopy width cultivar was registered for Crispin on MM.106 (98.24cm) followed on M.26 (47.12cm) whereas Granny Smith on similar rootstock recorded (65. 64cm) and (41.45cm) least. Among the two rootstocks lower vegetative characteristics was induced by M.26 compared to MM.106 rootstock which induced higher (Figure 1 and 2), confirming previous studies {2} {1} and {7}. The assumption is that, rootstock, or possibly its graft union alters the ratios and concentrations of the growth promoting and maybe also inhibiting hormones which are translocated within the tree {4} {6}.



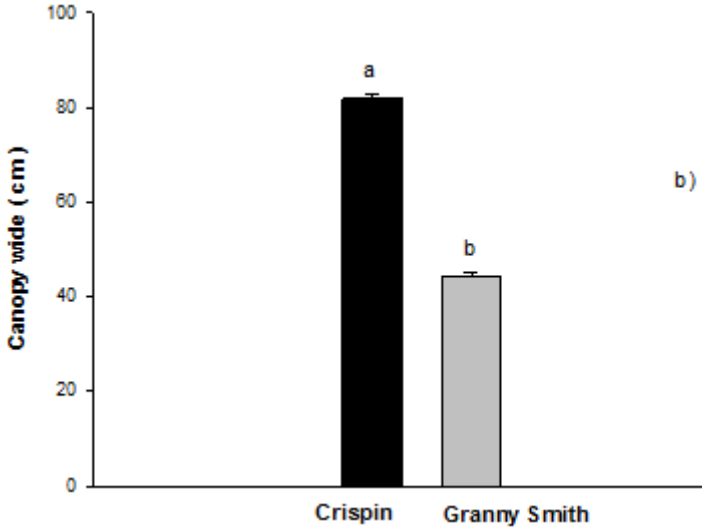
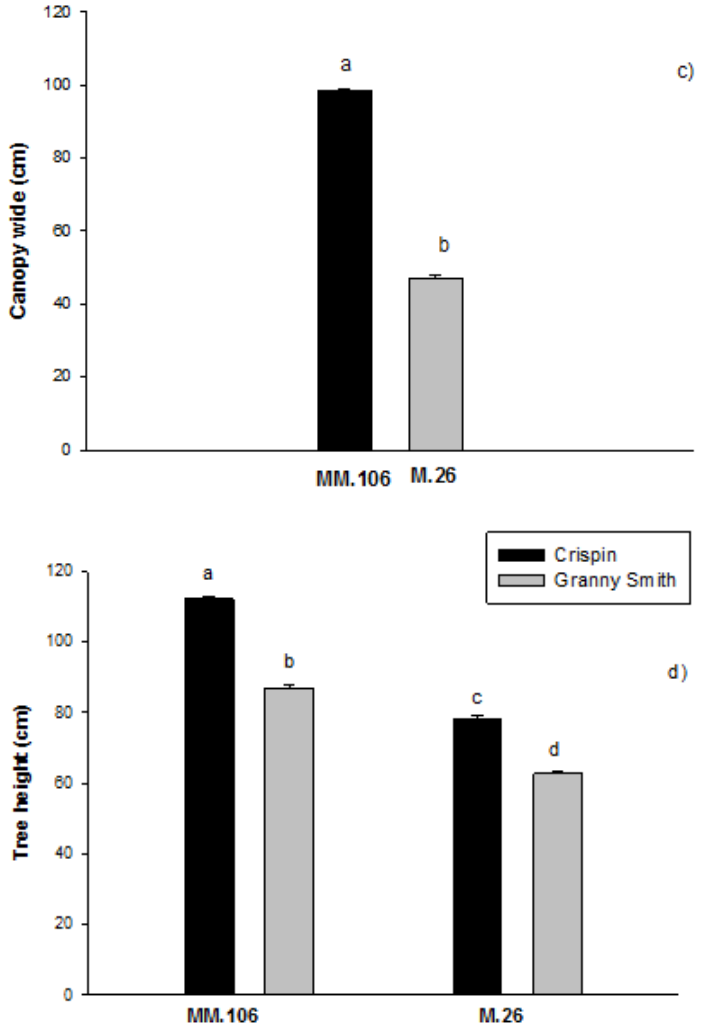


Fig 1 (a, b): Effect of cultivar on vegetative trait

In comparison with invigorating rootstock, the possible reason seems that, dwarfing rootstock reduces the speed of extension shoot growth throughout the season and often brings about an earlier termination of this shoot extension in the late summer or early autumn {13}. This effect and changes in tree habit towards more horizontal branch orientation {12} together account for the effect of the dwarfing rootstock in reducing the size of apple-scion trees.



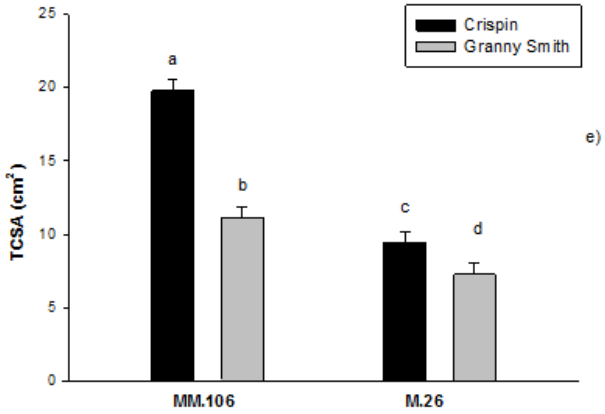


Fig 2 (c, d, e): Effect of cultivar and rootstock interaction on vegetative traits (means, with similar letters are not significantly different at the 1% probably level using Duncan multiple range test).

Differences in TCSA and number of branches indicate that rootstock control the tree size {11}. According to the result of this study MM.106 rootstock has controlled the tree size of Crispin more than Granny Smith cultivar resulted to the highest TCSA (19.78 cm^2) and the greatest number of branches (8). Early studies had suggested that vigour differences on rootstocks were possibly attributable to differences in the water absorbing potential of the roots of rootstocks {11}. The scion–rootstock combination is fundamental for optimal growth, water and nutrient uptake and transport. Rootstock effects occur because each rootstock has a different root growth pattern. Thus, under the study site of Chencha (tolola) district there is scarcity of water during the dry season when apple cultivars are at stage of fruiting. Thus, among the rootstocks used the highest TCSA of MM.106 favours maximum uptake of available water resulted in highest vegetative growth compared to M.26.

IV. Conclusion

Apple rootstock had significant influence on scion vegetative growth of cultivars. In the study site of Chencha (tolola) district under soil pH of 4.8, Crispin was productive on MM.106 and least on M.26. Thus, M.26 was not recommended for grafting with Crispin whereas, Granny Smith vegetative growth was influenced by both rootstocks compared to Crispin.

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