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Estimation Compatibility of Grapevine Rootstock IAC572 with Registered Grapevine Varieties in Ethiopia

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Abstract: Grapevine (*Vitisvinifera)* belongs to the family Vitaceae genus Vitis containing 79 accepted species of vining plants in the flowering plant. It is very adaptable plant and can grow in many environments and soil conditions. Soil salinity has become the major limiting factor in many tropical areas like Ethiopia where irrigation is the major means of grape production. This calls for the use of salt tolerant rootstocks in the system. IAC 572 is one of the salt tolerant varieties developed for tropical environment. It is an inter-specific cross between VITIS TILIAEFOLIA X MILLARDET ET GRASSET 101-14. Graft success is more likely when the scion and rootstock are closely related or of the same species. But it can vary substantially even among related species and clones within species. Therefore compatibility study was needed to see if the interspecific cross IAC 572 is compatible with the varieties that already are in production. Wine grape varieties Sangiovese and Chenin Blanc were cleft grafted on one year old IAC 572 rootstock under lat house condition. All the necessary graft compatibility parameters were collected in due time. The percentage of callus production ranged from 68.0 percent for Chenin Blanc to 41.1.0 percent for Sangiovese released grapevine varieties. Chenin Blanc had a higher transplant compatibility rate of 53.3 percent than Sangiovese, who had a graft compatibility rate of 40%.

Keywords: *Vitisvinifera*, Rootstock, Scion, Compatibility, Soil Salanity

1. Introduction

The genus Vitis, which contains 79 recognized species of vining plants in the flowering plant, belongs to the Vitaceae family. The genus Vitis is separated into two subgenera: Euvitisplnch, which has 38 chromosomes (n=19), and MuscadiniaPlnh 40, which has small clusters [4]. According to [2], the crop's principal source of origin is the Transcaucasia region of the main canter of central Asiatic provenance. It is mainly grown at latitudes from 50°N to 30°N and 40°S to 30°S, that approximate to the 10°C and 20°C isotherms [12]. *Vitisvinifera* is the most flexible tree crop, which can grow in varying climate conditions. Mediterranean countries with warm dry summers and cool wet winters have the most suitable climates for grapevine production and are the world leading producers. However, countries in the humid tropics practice viticulture by manipulating agronomic, viticulture practices, and careful disease management.

Grapevine production in Ethiopia is concentrated in the Rift valley area of the country which is characterized by high temperature and lower altitude with minimum rainfall. This makes the production is largely depend on irrigation. Soil salinity has become the major limiting factor in many tropical areas like Ethiopia where irrigation is the major means of grape production. Number of researches confirmed the occurrence of soil and water salinity in the irrigated areas of the rift valley and lowlands irrigated areas of the country [11, 14, 15]. This affected area is estimated to be 11,033,000 hectares of land [1].

Grape production and quality are highly affected by soil salinity. Vines grown on saline soils exhibited oxidative stress, water loss, photo inhibition, growth inhibition and necrosis [18]. Salt tolerant rootstocks has the mechanism to exclude salt from their shoots and roots and can guard the scions grafted on them from accumulating high amount of saline ions [17].

The IAC-572-Jales rootstock has been widely used under the designation 'Virus-free Tropical Vine' since the early 1990s [13]. It is developed by Brazil Agronomical Institute of Campinas—IAC with inter-specific cross between VITIS TILIAEFOLIA X MILLARDET ET GRASSET 101-14. It was reported that this rootstock is a salt tolerant variety by maintaining somatic aperture and transpiration rate at higher NaCl concentrations [17]. In addition, it showed excellent performance (vigorous, good disease resistance and tolerate moisture stress) in preliminary observation at DebreZeit Agricultural Research Center Nursery.

Grafting has become more popular in recent decades for economically propagating horticulture crops [10]. Although it is thought that graft success is more likely when the scion and rootstock are closely related or of the same species, graft compatibility can vary substantially even among related species and grapevine clones [3].

The major purpose of this study was to look into the levels of compatibility between IAC-752 and the two wine grape varieties, Chenin Blanc and Sangiovese nursery level. These two varieties along with few others are the major varieties at large scale production in the vineyards of Ethiopia.

2. Materials and Methods

2.1. Description of the Study Area

The research was carried out at the DebreZeit Agricultural Research center in Ada district, East Shewa zone, Ethiopia. The site is 47 kilometers south of Ethiopia's capital, Addis Ababa. DebreZeit is situated at an altitude of 1900 meters above sea level and is located at 80 45N latitude and 380 59E longitude. The area receives 1100 mm of annual rainfall, with typical maximum and minimum air temperatures of 28.3°C and 8.9°C, respectively [9].

2.2. Experimental Materials

The study was conducted in the DebreZeit Agricultural Research Center. The experiment used one legally licensed root-stock variety, IAC 572, developed by the Brazil Agronomical Institute of Companies, as well as two released cultivars (Chenin Blanch and Sangiovese). Cuttings of the root stock with a length of 30-40 cm and 3-4 nodes were planted in polyethylene bag filled with nursery soil mix. Scion cuttings of the Chenin Blanc and Sangiovese were collected from an established mother plant collection at DebreZeit Agricultural Research Center. Grafting was done on a one-year-old rootstock with an un-burst 2-3 bud of about the same diameter of the scion.

2.3. Experimental Design, Trail Management and Season

Treatments were assigned to the complete set of experimental units at random throughout the treatments as a result of chance. The varieties were evaluated using a Completely Randomized Design (CRD) with three replications. In May of 2012, hand grafting was done using one-year-old rootstock under lat house. To give the grafted scions a better growing condition, the seedlings were covered with raised plastic coverings. Cleft grafting method was utilized. The graft union was covered with Parafilm plastic tape, which adhered effectively to the plant material and to itself, and kept the plant material from drying out as the grafts healed. All the necessary nursery management practice was given to the grafted seedlings. Data analysis was carried out with SAS software version 9.2, and mean separation was performed with List Significant Difference (LSD) at p< 0.05.

2.4. Data Collection

The following data were collected at appropriate time of development. Data for Root number, Root length, and bud burst of the scion were recorded at the end of the callusing Stage.

Root development level (0 to 4): 0= no root formation, 1= one-sided weak root formation, 2= two-sided root formation, 3 = three-sided root Formation and 4= four-sided [6, 7].

Grades of callus development at the grafting union were collected by visual observations according to [6] a scale of 1 to 4 was used, where: 1=no callus, 2=low, 3=intermediate and +4=high callus formation on graft union surface.

Callus formation rate (%): Percentage of callused grafted cuttings [6].

Shoot length (cm): measurements were taken based on scale ranging from 1 to 10 (Shoot length (cm) ≤ 10 cm: 1, 10.1-20.0 cm: 3, 20.1-30.0 cm: 5, 30.1-40.0 cm: 7, 40.1-50.0 cm: 9, ≥ 50.1 cm: 10, and

Shoot diameter (mm) ≤ 2.0 mm: 1, 2.1-3.0 mm: 3, 3.1-5.0 mm: 5, 5.1-7.0 mm: 7, 7.1-9.0 mm: 9, 10≥ : 10 [6].

Diameter of main scion shoots (mm): Measured by digital caliper at a point of grafted union, 5 cm above and 5 cm below the union [5, 6].

Length of main scion shoot (cm): Shoot length of grafting after lifting [5].

The data for bud-burst of the scion (%): Percentage of grafted Grapevines that have an adequate shoot length and diameter flushed from scion bud.

Data on root numbers were taken by counting each root: primary root were measured.

2.5. Growth Parameters

The callus formation grade on the graft union was used to determine whether the root stock and scions are compatible. According to the results of analysis of variance the callus formation rate and callus development rate of both grafted Chenin Blanc and Sangiovese were significantly different (P <0.05) (table 1). All other character, on the other hand, showed no significant differences. The callus development rate ranged from 68.0 to 41.1.0 percent for Chain blanc and Sangiovese respectively.

Table 1 Bud burst of the scion, Stem diameters and Callus formation of graft union, and Graft success at nursery (%) for Cheninblanc and Sangiovese grafted on IAC572.

3. Result and Discussion

The callus formation grade on the graft union is used to determine whether the root stock and scion are compatible. According to the result so the analysis of variance the callus formation rate and callus development rate of both grafted Chenin and Tikur released grape vine varieties were significantly different (*P<0.05*) (table 1).

All other character, on the other hand, showed nosignificant differences. The callus development rate of examined grafted Chenin and Tikur released grape vine varieties ranged from 68.0 to 41.1.0 percent, respectively.

Table 1. *Budburst of the scion, Stem diameters and Callus formation of graft union, and graft success at nursery (%) for Chenin and Tikur grape varietieswith IAC572.*

Grafted varieties	Budburst of the scion	Stem diameters			Callus formation of graft union		Graft success at nursery (%)
		5cmAGU	AGU	5cm BGU	Rate (%)	Level (0-4)	
Chenin* IAC 572	93.3	2.9	5.4	3.6	68.0^{a}	2.8^{b}	53.33
Sangiovese* IAC 572	92.9	2.4	3.8	2.6	41.1^{a}	1.33^{b}	40
Mean	93.1	2.63	5.24	3.57	55	2.07	46.67
LSD (5%)	ns	ns	ns	ns	*	*	ns

Another parameter that determines good compatibility between stock and scion is the grade of callus formation level on graft union. Cheninblanc grafted cuttings had the highest callus formation rate (68.0%t) and callusing level (2.8), while Sangiovese grafted cuttings had the lowest callus formation rate and callusing level (41.1 percent and 1.33). The findings coincided with [5] who also found that 8B grafted cuttings had the highest callus formation rate (97.7%) and callusing level (3.7), while 5C grafted cuttings had the lowest callus formation rate and callusing level (62.0 percent and 1.58).

Table 2. *Dataof Root and Shoot measurements of grafted Chenin and Sangiovese grape varieties with IAC572.*

Grafted varieties	Root measurement		Shoot measurement	
	Number	Length (cm)	Shoot length (cm)	Shoot diameter (mm)
Chenin*IAC572	16.87	2.2	16.87	2.2
Sangiovese*IAC572	10.53	1.7	10.53	1.73
Mean	34	5.25	13.7	1.97
LSD (5%)	ns	ns	ns	ns

Even though the statistical data of Graft success at nursery for Cheninblanc and Sangiovese showed no significant differences, the former delivers higher numerical data (53.3%) than Sangiovese, which showed 40% Graft success (table 1). This could be ascribed to the incubation room's well-controlled settings, particularly the dark. Rooting and callus production of woody plants require specific conditions and temperatures [8, 16].

At the beginning of the experiment almost all buds of Cheninblanc burst but most young shoots died due to bad weather condition at the nursery. As a result, the analysis of variance revealed no statistical difference (table 1). However when comparing numerical data, Cheninblanc was greater than Sangiovese in stem diameters, shoot measurement, and root measurement.

4. Conclusion

Even if most measured traits showed no significant difference between varieties, based on numerical data Cheninblanc showed better compatibility with the rootstock than Sangiovese. This study necessitated additional research done by including other scion and rootstock varieties and different grafting procedures with different times in order to identifying the optimal time and grafting methods.

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