International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 2835-2838

Received: 20-01-2018
Accepted: 23-02-2018

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Effect of various rootstocks on yield and chlorophyll content in leaf of wine grape varieties (*Vitis vinifera* L.)

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Abstract
The investigation was carried out at Instructional- cum- Research Farm of Department of Horticulture, College of Agriculture, Latur during the year 2010-2011. There were significant differences found in yield attributes *viz*; number of berries per bunch, weight of berry, number of bunches per vine, weight of bunch, yield kg per vine and yield Mt per hectare were maximum in Syrah-524 grafted on 110 R and physiological attributes i.e. chlorophyll the maximum chlorophyll 'a', chlorophyll 'b', and total chlorophyll contents recorded by Pinot Noir-15 grafted on 110 R was recorded non significantly.

Keywords: yield, berry, bunch, chlorophyll, grape, rootstocks

Introduction
Grape (*Vitis vinifera* L.) is an important temperate fruit crop of the world, which is well acclimatized to the subtropical climate and grown extensively in this climatic condition by adopting modified cultural practices. There are sixteen biproducts which are made from grapes *viz*, raisin, grape juice, squash, syrup, jam. jelly, vinegar, wine, pickles, chocolates, tartaric acid, oil, cattle feed etc. But looking to the world scenario of different bi- products, it was necessity to consider setting up of projects for manufacturing other value added products from grapes, such as good quality of wine so as to prevent losses, obtained more income and provide additional employment to rural people. Recently, the wine grape varieties, *viz;* Cabernet Sauvignon, Syrah, Pinot Noir, Cabernet Blanc, Ugni Blanc, Chenin Blanc are growing by using Dogridge rootstocks. 1103 P, 110 R, SO4 etc are vigorous growing rootstocks with dense and deep root system. There are some clones of wine varieties which are improved. It is need to see the influence of various rootstocks on yield and chlorophyll content of wine grape varieties. Hence, the present investigation was carried out.

Materials and mMethods
The experiment was carried out at instructional- cum- research farm. The clones of wine grapes varieties were used Ugni Blanc-380 grafted on 110 R, Sauvignon Blanc-160 grafted on S04, Viognier Noir-15 grafted on 1103 P, Semilon-909 grafted on SO4, Syrah-524 grafted on 110 R, Cabernet Sauvignon-15 grafted on 1103 P, and Pinot Noir-15 grafted on 110 R, among these Syrah-524, Cabernet Viognier Noir-15 and Semioln-909 were white varieties. Three rootstocks were used are 110 R, 1103 P and SO4. These grafts were planted with spacing 3m x 1.5m and trained on bower system.
Yield observation were recorded like number of berries per bunch, length of berry, diameter of berry, weight of berry, number of bunches per vine, length of bunch, width of bunch, weight of bunch, yield kg per vine and yield Mt per hectare and physiological attributes chlorophyll content.

Result and Disscusion
A. Yield Attributes
There was significant differences depicted (Table 1) in terms of number of berries per bunch among the different wine grape varieties grafted on various rootstocks. Thus maximum numbers of berries per bunch were observed in Syrah-524 grafted on 110 R (146.92), however, it was at par with Viognier Noir-15 grafted on 1103 P (137.63).

It might be due to the size of bunch and shape which might be due to the different stages of growth and fruitfulness of grape wine varieties. Similar finding is also observed by Havinal (2007) [5] and Kulkarni (2009) [10].

Regarding the data of length of berry were maximum seen in Ugni Blanc-380 grafted on 110 R (18.50 mm), however, it was at par with Viogneir Noir-15 grafted on 1103 P (17.90 mm). This difference in length of berry might be due to genetical influence in shape of the berry where some were with round berries. This type of study was done by Richard *et al*., (1999) [12], Havinal (2007) [5] and Kulkarni (2009) [10].

The result on diameter of berries showed variation is found in different graft union. The maximum diameter of berry was recorded in Ugni Blanc-380 grafted on 110 R (13.75 mm), however, it was at par with Syrah-524 grafted on 110 R (13.26 mm). This type of study was done by Kadu (2002) [9] gave the diameter of berries range from 10.00 to 15.00 mm which was reported by Havinal (2008) [8] and Kulkarni (2009) [10].

The data on weight of berry presented in (Table 1) revealed that a wide range it upto 1.35g to 1.82 g. In this respect, Ugni Blanc-360 grafted on 110 R had the highest weight of berry (1.82 g), however, it was at par Syrah-524 grafted on 110 R (1.68 g). The variation in the weight of berry might be due to the difference in diameter of berry and length of berry. This type of study was done by Richard *et al.,* (1999) [12] where, grape wine variety Merlot had 1.10 g of average single weight of berry.

About the number of bunches per vine were found in significantly maximum (39.88) were recorded in Syrah-524 grafted on 110 R. The minimum number of bunches per vine was recorded in Pinot Noir-15 grafted on 110 R (15.96). Affonso and Striegler, (1999) [1] recorded a 59 to 124 bunches in six wine grape varieties, range from 131 to 162 bunches per vine recorded by Walker *et al.,* (2000) [13] in variety Shiraz which were evaluated rootstocks under study and reported that there was no effect of rootstock on number of bunches per vine, weight of bunch, weight of berry and yield. Kadu (2002) [9] recorded a range of 5.17 to 33.43 bunches per vine in 15 grape varieties. Martin *et al*., (2006) [11] recorded range of 55 to 74 bunches per vine in different clones of Pinot Noir. This type of study was also done by Havinal (2007) [5] and Kulkarni (2009) [10].It might be due to the difference between number of canes, drop of flower buds or berries, disease intensity on flower buds and at the stage of berry development.

The data (Table 1) revealed that the highest average weight of bunch was recorded by Syrah-524 grafted on 110 R (248.31 g), which was significantly higher than other varieties. The similar type of study was done by Kadu (2002) [9], Havinal (2007) [5] and Kulkarni (2009) [10] in different wine grape varieties and recorded a range of bunch weight from 28.90 g to 317.0 g, 114.83 g to 147.76 g and 97.69 g to 165.88 g, respectively. The weight of bunches all the varieties studied are within the range. This difference in weight of bunch might be due to difference between size of berry and weight and also due to size of canopy where the high weight of bunch was observed in varieties which had large canopy size.

The maximum length of bunch was noted in Syrah-524 grafted on 110 R (11.04 cm). The minimum length of bunch was recorded in Pinot Noir-15 grafted on 110 R (7.11 cm). Similarly with respect to width of bunch seven wine grape varieties grafted on different rootstocks had the range 3.53 cm to 4.61 cm. The maximum width of bunch was recorded in Semilon-909 grafted on SO4 (4.61 cm). The similar type of study was done by Havinal (2007) [5], recorded the range of 6.22cm to11.00cm length of bunch in 12 wine grape varieties.

The maximum yield per vine and yield per hectare was recorded in (Table 1) Syrah-524 grafted on 110 R (9.11 kg/ vine, 19.89 Mt/ ha). The minimum yield per vine and yield per hectare was recorded in Pinot Noir-15 grafted on 110 R (2.39 kg/ vine, 5.21 Mt/ ha). Walker *et al.,* (2000) [13] recorded 14.8 kg to 19.2 kg per vine Shiraz. Kadu (2002) [9] reported the range of yield per vine was (0.37 to 6.82 kg/vine and 1.66 to 30.33 Mt/ha) in different grape wine varieties. Martin *et al.*, (2006) [11] recorded the yield per vine with the range of 7.20 kg to 10.00 kg in different clones of chrdonnay. Havinal (2008) [8] recorded the yield per vine with the range of (2.27 to 12.19 kg /vine and 5.04 to 27.09 Mt/ha) in twelve wine grape varieties and Kulkarni (2009) [10] (5.41 kg to 9.07 kg / vine and 14.42 to 24.19 Mt/ha) in six wine grape varieties. The variation in the yield per vine and yield per hectare might be due to the varietal character or due to difference in number of bunches per vine, weight of bunch which had direct effect on yield per vine and yield per hectare.

Table 1: Effect of various rootstocks on yield attributes on wine grape varieties

Treatment No.	Treatments	Number of berries per bunch	Length of berry (mm)	Diameter of berry (mm)	Weight of berry (g)	Number of bunches per vine	Weight of bunch (g)	Length of bunch (cm)	Width of bunch (cm)	Yield (kg/ vine)	Yield (Mt/ ha)
T_1	Ugni Blanc -380 grafted on 110R	115.14	18.50	13.75	1.82	28.19	210.71	10.13	3.87	5.96	13.01
T_2	SauvignonBlanc-160 grafted on SO4	103.18	15.45	12.03	1.44	20.92	148.58	8.51	3.59	3.42	7.46
T_3	Viognier Noir-15 grafted on 1103P	137.63	17.90	12.94	1.56	37.86	216.07	9.98	3.74	7.98	17.42
T_4	Semilon-909 grafted on SO4	98.76	17.40	12.63	1.50	19.25	148.16	9.46	4.61	2.86	6.24
T_5	Syrah-524 grafted on 110R	146.92	17.73	13.26	1.68	39.88	248.31	11.04	4.22	9.11	19.89
T_6	Cabernet Sauvignon-15 grafted on 1103 P	105.60	14.13	11.17	1.38	17.19	145.72	10.43	3.53	2.51	5.47
T_7	Pinot Noir-15 grafted on 110R	84.22	14.11	10.96	1.35	15.96	114.49	7.11	4.01	2.39	5.21
	S.E.±	3.19	0.22	0.21	0.046	0.63	5.49	0.024	0.0097	0.20	0.44
	C.D. at 5%	9.83	0.68	0.66	0.14	1.95	16.91	0.075	0.030	0.62	1.36

B. Physiological attributes (Chlorophyll content (mg g^{-1})

The data shown in (Table 2) resulted that physiological characters like chlorophyll 'a', chlorophyll 'b' and total chlorophyll content of each variety depends on the various rootstocks grafted on wine grape varieties. As the chlorophyll contents of leaves of various rootstocks grafted on wine grape varieties were found non-significant. The highest chlorophyll 'a', chlorophyll 'b' and total chlorophyll was recorded in Pinot Noir-15 grafted on 110 R (1.29 mg g^{-1}) (0.48 mg g^{-1}) and (1.77 mg g^{-1}). The lowest chlorophyll 'a' Ugni Blanc-380 grafted on 110 R (1.24 mg g^{-1}), Syrah-524 grafted on 110 R (1.24 mg g^{-1}), while the minimum value of chlorophyll 'b' was recorded in Syrah-524 grafted on 110 R (0.41 mg g^{-1}) and Viognier Noir-15 grafted on 1103 P had the minimum total chlorophyll (1.56 mg g^{-1}). The rootstocks 110 R, 1103 P, and SO4 influences the chlorophyll contents of leaves which might be resulted into maximum leaf area, colour of leaf, rate of photosynthesis. The content of nitrogen and iron might be increased with increase in chlorophyll contents. The dark colour leaves have maximum chlorophyll contents. The chlorophyll 'a' concentration tended to decrease as the leaves were progressively situated deeper in canopy. As the leaves were progressively situated towards the periphery of the canopy, maximum chlorophyll 'a' and chlorophyll 'b' concentration were reached later during growth season.

The increase in the chlorophyll content was accompanied by relative increase in accessory pigment chlorophyll 'b' over that of chlorophyll 'a' as depicted by a decrease of chlorophyll a/b ratio (Boardman 1977) [3]. The chlorophyll content is linked directly to photosynthetic potential and primary production (Curran *et al.,* 1990) [4]. Additionally, chlorophyll content gives an indirect estimation of the nutrient status as considerable leaf nitrogen in incorporated in the pigment. (Filella *et al.,* 1995) [4]. Leaf chlorophyll amounts are affected directly by plant stress and senescence. (Hendry *et al.,* 1987) [6]. The Findings are in conformity with that reported by Bertamini (2002) [2].

Table 2: Effect on various rootstocks on chlorophyll contents in the leaf of wine grape varieties.

Treatment No.	Treatments	Chlorophyll 'a' (mg/ g^{-1})	Chlorophyll 'b' (mg/ g^{-1})	Chlorophyll total (mg/ g^{-1})
T_1	Ugni Blanc -380 grafted on 110R	1.24	0.42	1.66
T_2	SauvignonBlanc-160 grafted on SO4	1.25	0.43	1.68
T_3	Viognier Noir-15 grafted on 1103P	1.27	0.46	1.56
T_4	Semilon-909 grafted on SO4	1.26	0.44	1.69
T_5	Syrah-524 grafted on 110R	1.24	0.41	1.65
T_6	Cabernet Sauvignon-15 grafted on 1103 P	1.28	0.47	1.75
T_7	Pinot Noir-15 grafted on 110 R	1.29	0.48	1.77
	S.E.±	0.01	0.01	0.06
	CD at 5%	NS	NS	NS

Conclusion

Considering the significant influence on yield attributes, it can be concluded that the wine grape variety Syrah -524 grafted on 110 R was found to be significantly better in number of berries per bunch, number of bunches per vine, weight of bunch, length of bunch. While, Ugni Blanc-380 grafted on 110 R was to be significantly better in length of berry, diameter of berry and weight of berry. Whereas, Semilon-909 grafted on SO4 was to be found significantly better in width of bunch. While, Syrah-524 grafted on 110 R was found to be significantly higher in yield. The wine grape variety Pinot Noir-15 grafted on 110 R showed the maximum chlorophyll contents was found to be non-significant.

Acknowledgements

The authors wish to thanks Head, Department of Horticulture, my research guide for providing necessary facility and guidance for conducting the experiment.

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