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Developments in Blackberry Breeding

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Abstract: This research examined developments in blackberry breeding. Adaptation, yield, plant habitus, endurance to diseases and detrimentals and fruit qualification researched in the aims of blackberry breeding. Hybridizing breeding between types, poliploidi and mutation breeding studied in methods of raspberry breeding. Flowering and dulling, Seed development and Making sprout, F1 plants in hand were stated important that in hybridizing techiques. Micro propagation, somatic selection, repetition of DNA, genetic definition, (Random Amplification of Polymorphic DNA) RAPD, (Restriction Fragment Length Polymorphism) RFLP, (Polymerase Chain Reastion) PCR and (Simple Sequence Repeat) SSR researched new techniques used in breeding programs. Furthermore, we gave suggestions for future. And, culture kinds have given observed.

Key words: Blackberry, breeding, breeding methods.

INTRODUCTION

When blackberries, raspberries and hybridspecies are compared, the increase in the production can be obviously seen. However; the development of cultural systems and the protection of the variations can be encouraged by increasing the amount of saplings. The qualification of most hybrid species is good, its taste contains characteristic features and they are new cultural species which have developed plant habitus shows spineless features, grows half or completely perpendicular and owns absorbent roots. They have an important role in mechanical harvest and cultural operation.

Unlike the raspberries, in blackberries, it isn't found side branches which always stay on the plant for long years and in most species, the shoots are formed by a single root. Blackberries use their spine in order to climb. Shoots of blackberries are for three years. In first year, there is a shoot bud; and in second vegetation period, from this bud, a baby shoot develops by getting out to the soil and in third year, we can find fruits on this shoot which dies in that year[1].

Jennings[12], made the classification of blackberry like this: blackberries take part in the subspecies of Eubatus, Caesii, Suberecti and Corylifolii. Eubatus forms from two parts, the names of which are Moriferi and Ursini.

The aims of blackberry improvement: Production of blackberry is not as common as the raspberry's. When we say adaptation in improvement, low heat, short product, its term, high heat, low level of coldness requirement, excessive wind, high density of light and drought come to mind. In strong species, we can find *R. allegheniensis*, *R. argutus*, *R. caesius* and *R. canadensis*. The species which require summer heat and low coldness are *R. trivialis*, *R. cuneifolius*, *R. frondosus* and *R. rubrisetus*[12,31].

Among cultural species, *Rubus macrocarpus* Benth type and Columbian Giantin fruits which belong to subspecies of Orabutus are big. There is a strong relationship between the yield of species and the genotype of plants. The yields of Brazos, Mammoth, Aurora, Chester Thornless, Flordagrant, Hull Thornless, Marion, Silvan, Cheyenne, Shawne, Tayberry, Sunberry types are really good[12,13].

The yield of Cherokee, Cheyenne, Commanche, Shawne, Choctaw, Black Satin, Chester Thornless, Dirksen Thornless, Youngberry, Hull Thornless, Loganberry, Thornfree, Boysenberry, Chehalem, Flordagrand, Marion and Olallie types are really good[20].

In blackberry improvement process, development of plant habitus is important. An ideal habitus is spineless or nearly spineless and has shoots which can stand perpendicularly on its own. "Nahavo" is the first type which contains all these criteria[19]. Perpendicular growth of plants also became the topic of Arkansas improvement program. As a result, the types which grow perpendicularly on their own are formed, the names of which are Darrow, Early Harvest, Lawton and Eldorado. *R. canadensis*, *R. allegheniensis*, *R. argutus* and *R. frondosus* are the types which grow perpendicularly. The development of plant habitus is related with genotype.

In blackberry improvement, when the endurance to diseases and detrimental problems are designated, chemical controls are less used. Hall[9] and

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Jennings *et al*.[13] examined the source of cultural species and their types enduring to diseases. Strong types are designated against most serious diseases.

Black Satin, Boysenberry, Brison, Cheyenne, Dirksen Thornless, Kotata, Silvan, Youngberry types and *R. laciniatus* type are enduring to anthracnose. Loganberry, Himalaya Giant, Evergreen, Lawton, Cascade, Chehalem, Ollalie, Mammoth, Marion, Merton Thornless and Phenonmenol types and *R. ursinus*, *R. macropetalus* types are enduring to verticillium. Chester Thornless, Dirksen Thornless types are enduring to shoot thrush. Loganberry, Tayberry types and R. idaeus type are enduring to mildew disease[4].

Fruit qualification in blackberry improvement program is same with the features of fruit qualification in raspberry improvement. Fruit qualification, substance which can melt, acid, color, endurance, toughness, fruit shape, seed (pyrene) shape, easy abscission and ripening season are the features that will be searched. Ideal color for fresh consuming is bright black.

Smoothstem, Thornfree, Darrow, Black Satin, Hull Thornless, Dirksen Thornless, Chester Thornless and Olallie[11,20,28] emphasized that among hybrid types, Boysenberry, Youngberry[27] Tayberry[12]'s fruit qualifications are good.

Toughness and endurance are important in terms of shelf-life. Kotata's species is the most enduring type[7].

Greatness of fruit is important in terms of both hand and mechanical harvest. Shape of fruit has a quantitative feature and related with Heritage[2].

Method of blackberry improment: In blackberries, ploidy diploid is between (2n=14) and dodekaploid (2n=84). Anaploidy occurs at the high level of ploidy[9]. Diploid blackberries are born by sexually[9]. Diploid blackberries multiply sexually. R. procerus multiply with apomixes of cold climate but multiply sexually of mild climate[9]. Although blackberry hybrid species have facultative parents, they multiply sexually. Sexuality is dominant and pseudogamy is a recessive issue[12].

Hybridizing methods:

Flowering and Dulling: The amount of flowers on the point is less than 10 while it is nearly 60 in hybrid species[9,26]. Samples in their growth are more than raspberries when it is compared.

Blackberry species have 3 year shoots; they need a dormant term before they become fruited. The amount of fruits in species such as *R. procerus* decreases fifty-fifty before they die. Unlike them, fruits are observed on the most blackberry and raspberry habitus' two year old aged branches. Beginning of flowering usually starts later than raspberries. Flowering doesn't start before autumn. In some culture species such as "Ashton Cross", flowering doesn't start until the late autumn[12].

Seed development and making sprout: Seeds which arise with the hybridization of blackberries resemble to the seeds which are with the hybridization of raspberries. However; blackberry seeds are two times more stagnant because, seed scales are tough and their seeds have double embryo[8]. As a result, sprouting becomes both late and at a low level. By using sulphuric acid in blackberries, sprouting time difference between blackberries and raspberries was compared. According to Ourecky[26], this time period is between 40 and 60 minutes, according to Nybom[23] two hours and according to Moore *et al*.[21] it is 3 hours. In order to sprout blackberry seeds, seeds are wetted in sodium hypochlorite solution at 12 %, between 48 and 96 hours and they are kept waiting for 7-8 weeks at between 29 and 24 C degree[8] and as an addition light must be used. Also hybrid species, like the most raspberry species, can be sprouted in a short time[9].

F1 Plants' in hand: Spineless is an important topic in improvement program. This effect eachfamily hybridization impress of recessive gene. This feature is found in *R. urmifolius*, inermis, in terms of blackberries and in Burnetholm in terms of raspberries[9]. Basic parts of ripe plants are spineless.

Regions where cultural species are grown for financial aim are done by following the specific features of culture and selection species of improvement program. For example, Marion, which is the most important culture type of Oregon, has a very good fruit qualification. Species, which grow perpendicularly in order to be suitable for mechanical harvest, are compared in Arkansas, where the improvement studies are carried out. These species are Cherooke, Comanche, Cheyenne, Choctaw and spineless Nahavo.

In some places where the blackberry production is done, coldness requirement can be unimportant for production. This program founded successful varieties in New Zealand, Brazil[9,18].

New methods that are used in blackberry improvement: Micro propagation is searched for blackberries by Caldwell[2], Donnelly and Daubeny[5]. The same procedure is also valid for raspberries. From hybridizing techniques, micro propagation is used in order to obtain deprive clone from virus[5]. In blackberry improvement programs, by micro propagation and cell cloning, formation of species are encouraged.

Spineless is important in Thornless Evergreen and Thornless Loganberry species. With somatic selection method, Thornless Evergreen type was formed from blackberry culture species[17]. Two plant types were used. First type is dwarf type; in this, shape, habitus and bud growth features were emphasized. The other type was formed in its normal size but showed less bud development. In both species, whether there are thorns and their root segments were considered. It is found that

Table 1: Features of Some Blackberry and Hybrid Species, which were obtained with Materials.

Name of species	Parent combination	Features features	Breeding place	Breeding year
Adrienne	Silvan X ?	Early, spineless, large production amount	England	1995
Arapaho	Ark.631 X Ark.883	Early, spineless, grow perpendicularly, fruit is dark black	Arkansas	1982
Cacak Thornless	Dirksen X Black Satin	Middle late, fruits are large	Russia	1984
Cowley	-	Early, grow perpendicularly, color is bright, taste	-	-
Cox's Miracle Berry	-	Spineless, grow perpendicularly	Russia	1988
Douglass	Lawrence X Sander	Highly productive, suitable for mechanical harvest, fruits are conic	Germany	1984
Doyle's Blackberry	-	Half perpendicular, spineless	Washington	1977
Ever Thornless	A sexual clon to thornless evergreen	Spineless, fruit taste is good, shoots are long	-	1995
Exel's Everbearing	Thornfree X Treeform	Half perpendicular, fruit are sweet and soft	-	-
Fantasia	-	Thorny, fruit is dark black, yield is good, sensitive to the red spider	England	1994
*Fertodi Botermo	Logan X (R. caresius X Lloyd George)	Early, fruit is large, color is dark red	Germany	1968
*Fertodi Hungaria	Logan X (R. caresius X Lloyd George)	Plant is long, fruit is bright red	Germany	1963
Helen	Silvan X ?	Early, spineless, fruit qualification is good	England	1997
Kiowa	Ark.791 X Ark.1058	Grow perpendicularly thorny, storage life is long	Arkansas	1996
*Mahana	Aurora X Loganberry	Fruit is large, color is wine red	New Zeland	1981
*Mapua	Mutation to boysenberry	Suitable for mechanical harvest	New Zeland	1994
*Murrindindi	Silvan X spineless blackberry	Spineless, fruit qualification is good	Australia	1994
Orkan	Black Satin X Ark.1084OP	Spineless, sensitive to botrytis	Poland	1983
PerCan	Selection ot R. canadensis	Spineless, enduring to the colds, fruit is dark black	Canada	1990
*Ranui	Aurora X Marion	Fruit is medium, color is dark red	New Zeland	1983
*Riwaka Tahi	Aurora X Boysenberry	Thorny, fruit color is wine red	New Zeland	1983
*Taranaki	Aurora X Cherokee	Thorny, suitable for fresh consuming,	New Zeland	1982
Tasman	Clonal selection to Boysenberry	Yield is extremely high	New Zeland	1994

*Hibrit species that were obtained with the hybridizing Raspberry and Blackberries

normal plants are thorny and the dwarf ones are without thorns. By hybridizing both thorny plants and the plants without thorns, several plants without thorns were formed[10]. In all combinations of thorny and spineless species, the species which multiply sexually were formed. Spineless is dominant and is controlled by a single gene.

DNA transfer is also observed in blackberries. McNicol and Graham[16] said that, Cowpea trips in blackberry and raspberry-blackberry hybrid species transfer with inhibitor. This gene is supposed to be enduring against sticky spiders.

RFLP (Restriction Fragment Length Polymorphism) analysis has been used for blackberry breeding. In blackberry genotype, isoenzymes analysis has never been used so far; however, RFLP analysis has been used in order to distinguish culture species which has genetic relationship and designate them[24,25]. RFLP analysis is used for defining DNA in chloroplast and for defining the amount of cytoplasmic differences in *Eubatus* type and hybrid species[32].

Raspberry Bushy Dwarf Virus (RBDV) was discovered in 'Marion' blackberry at the NWREC. RBDV had no effect on cane growth or fruit number, but reduced yield (40 to 50%), fruit weight (23 to 40%) and drupelet number per fruit (36 to 39%) compared to uninfected plants. Blackberry fields to test for the presence of RBDV using ELISA[15].

The other method simple sequence repeat (SSR) molecular markers derived from *Rubus* and *Fragaria* L. (strawberry) are available for use with *Rubus* mapping populations. At last, SSR primer pairs tested may be useful for genetic mapping in both the blackberry population and at least one of the raspberry populations. They found large fruit size, fruit firmness and quality, disease resistance and winter hardiness varieties[6].

PCR (Polymerase Chain Reaction) revealed that the new virus designated as Blackberry yellow vein associated crinivirus recently identified[14]. PCR is a method that using definition of disease.

Few studies with Random Amplified Polymorphic DNA (RAPD) markers have focused on blackberry genotypes. In this study we attempted to differentiate several blackberry and raspberry cultivars for genetic identification by pedigree and RAPD analyses. Blackberries averaged 55% similarity amongst themselves and 22% to raspberries. Overall, pedigree and RAPD data should be interpreted separately, with the RAPD data likely being more reliable[30].

Suggestion for future: The amount of blackberry reform program which is carried out worldwide is really low. Despite this, reform programs which are done recently are really successful. Reform programs in Arkansas University were carried out with the sorts among Indian Tribe series. As a result, cultural types, which grow perpendicularly and suitable for mechanical harvest, were found.

Biotechnology has a significant role in reform programs. Usually more importance will be given for the growth of plants without thorns[22]. Financial features also will gain importance. For example, endurance against disease and detrimental problems will especially be searched in the species which multiply by cell cloning[16]. DNA repetition technology will increase the augmentation potential blackberry species production. In order to increase the production impact, new reform programs must be formed or the old ones must be added liveliness.

Culture kinds observed: Features, obtained so far, associated with several blackberry hybrids and is given in Table.1.

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