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SHORT COMMUNICATION

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Study of inter-generic hybridization possibility between *Salix aegyptica* and *Populus caspica* to achieve new hybrids

A. Ahmadi[a,*], D. Azadfar[b], A. Jafari Mofidabadi[c]

[a]*Gorgan University of Agricultural Sciences and Natural Resources, Iran.*
[b]*Gorgan University of Agricultural Sciences and Natural Resources, Iran.*
[c]*Agricultural Research and Education Organization, Iran.*
*Corresponding author. E-mail: ahmadi.1870@gmail.com

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Abstract

Hybrids as various resources have valuable importance in tree breeding. Today, improvement programs by using poplar and willows and their hybrids play basic role in supplying wood and decreasing pressure on natural forests. This research was carried out in order to study inter-generic hybridization possibility between *Salix aegyptica* and *Populus caspica* species from Salicaceae to achieve new hybrids. Embryo rescue technique was used in order to produce new inter-generic hybrids in salicaceae. The experiment was performed in factorial completely randomized design with 3 replication in embryo developmental stages and different media treatments. The analysis of data showed that inter-generic cross ability between *Salix aegyptica* and *Populus caspica* was possible and 14 day after pollination and MS medium containing 3 percent sucrose were the best time and medium for obtaining high amount of germinated hybrids.

Keywords: Inter-generic hybridization; *Populus caspica*; *Salix aegyptica*; Tree breeding.

Introduction

The poplars, genus Poulus and the willows, genus Salix belong to the salicaceae family (FAO, 1972). Willows are rich in species and gene resources and they are easy to cross and vegetative to propagate. They are typical short-rotation species because of early fast growth. Their wood is white and has even structure (Mingiian et al., 2000). Also, willows play important role in natural communities, restoration of rivers edge and biomass production. Willows have main features as high growth speed, good performing in lowland areas and having positive effects such as medical consumption and prevention from erosion (Drusilla and Bertholdsson, 2000; Bergner, 2001).

Poplars are fast growth, ease of vegetative propagation and versatility of end uses determined the special role of the genus Populus in agricultural systems. Today, poplars represent an important growing stock of poplar is in natural forests (Confalonieri et al., 2003). Poplars are often considered as part of agro-forestry system that are used for

producing wood, fuel and windbreaker (Dickmann, 2006). However, long generation time of trees, the presence of seasonal dormancy and the prolonged period required for evaluation of mature traits are strong limitations for classical breeding and selection. The development of methods for *in vitro* culture and genetic engineering has increased the possibility of producing poplar genotypes improved in insect pest resistance, herbicide tolerance, growth rate and wood quality or reduction in undesirable traits (Confalonieri et al., 2003).

Inter-specific and intra-specific hybridization in Poplar genus (Sout et al., 1927; Mofidabadii, 1998; Jafari mofidi and Modir Rahmati, 2000; Asadi et al., 2001; Kalagari et al., 2003) and willow (Argus, 1974 and 1986; Mosseler and Papadopol, 1989; Orians and Fritz, 1995; Hardig et al., 2000; Orians et al., 2000; Fritz, 2006) have been done by many researchers that they lead to increase genetic resources to achieve heterosis. Inter-generic hybridization between willow and poplar genera have been reported by Zenkteler et al. (2005) that they examined the inter-generic cross ability of *salix verminalis* and four populus species.

Hybridization between forest trees is one of method to increase genetic diversity and to obtain genetic improvement. These methods result in phenotype and genetic variation which increase basis materials for improvement works (Heszky et al., 1992). This article was performed in order to study inter-generic hybridization possibility between *salix aegyptica* and *populus caspica* to achieve new hybrids in salicaseae as woody biomass resources.

Materials and Methods

Pollination was performed with Twig and Pots system (Jafari mofidi and Modir Rahmati, 2000) and *Salix aegyptica* stigma were pollinated with *Populus caspica* pollens. The explants were cultured at 10 days after pollination and were prolonged in 14 and 21 days. Before transferring of ovaries to media, the ovaries were surface-sterilized aseptically.

The ovaries were cultured on MS and Half-MS medium (Murashige and Skoog, 1962) containing 20 and 30 g/l sucrose and 8 g/l agar. The Cultured ovaries were put in growth cabinet in 16 hours light conditions and 4500-5000 lux in temperatures varying from 15 °C at night to 20-25 °C during the day. The number of germinated ovules was recorded daily for six months. The specimens were sub-cultured every 15 days. Variance analysis of germination parameter was carried out in factorial experiment completely randomized design at 3 replication with embryo developmental stage (10, 14, 21 day-old after pollination) and medium treatment (MS and Half-MS without plant growth regulators). Then the mean differences among media and time and their intercept effects were compared by using Duncan multiple comparisons.

Results and Discussion

The results of this research indicated that the initiation time of ovaries germination in *Salix aegyptica* × *Populus caspica* embryos occurred at 7-10 days after transferring of

ovaries to media that This is in accordance with the results obtained by Mofidabadi et al. (1998) and Kalagari et al. (2003).

Variance analysis of data was demonstrated that there was significant differences at 1% level in germination of inter-generic hybrid ovaries (Table 1) between embryo developmental stages (10, 14 and 21 days). The highest and lowest ovule germination was obtained in ovaries collected at 14 and 21 day-old after pollination, respectively. Jafari Mofidabadi (2005, 1998) and Raquin and Trousard (1993) also observed the highest germination in 14 day-old embryos. Moreover, the analysis of embryogenesis in this inter-generic hybridization indicated that the lowest germination percentage in ovary culture was observed in 21 day-old embryos that it is similar to Jafari Mofidi et al. (2006, 1998) results. This decreasing in germination is because of white cottons that surround ovules and exist at late development of ovaries.

Table 1. Germination variance analysis in embryo developmental stages and medium type.

Source	Degree of freedom (df)	Mean Square (ms)
Corrected Model	11	199/818**
Intercept	1	464/815**
media	3	349/750**
age	2	17/343**
media * age	6	6/917*
Error	24	
Total	35	

**significant at the 0.01 level.
*significant at the 0.05 level.

Also, the effect of several media components on the germination percentage of ovules in this inter-generic cross by using ovary culture showed significant difference among media components. Maximum percentage of germination was observed on media containing the full concentrations of micro-and macro-nutrients of the MS medium supplemented with 30 g/l sucrose and minimum percentage of germination was resulted in media containing the half concentrations MS supplemented with 20 g/l sucrose.

In addition, there was significant difference on interaction effects between different embryo developmental stages and media. Furthermore, based on Duncan multiple comparisons in simultaneous consideration of media and embryo developmental stages on ovaries, the highest and lowest germination have been obtained from ovaries which were collected at 14 and 21 days after pollination and transferred to MS medium supplemented with 30 and 20 g/l sucrose, respectively (Figure 1).

In general, this research may allow breeders to develop inter-generic hybrids (*Salix aegyptica* × *Populus caspica*) through hybridization using new tissue culture methods. More research is need for improving genetic variability of inter-generic hybrids in salicaseae. Also, more efforts are necessary on its heterosis plants and commercial characteristics of this new inter-genetic hybrid.

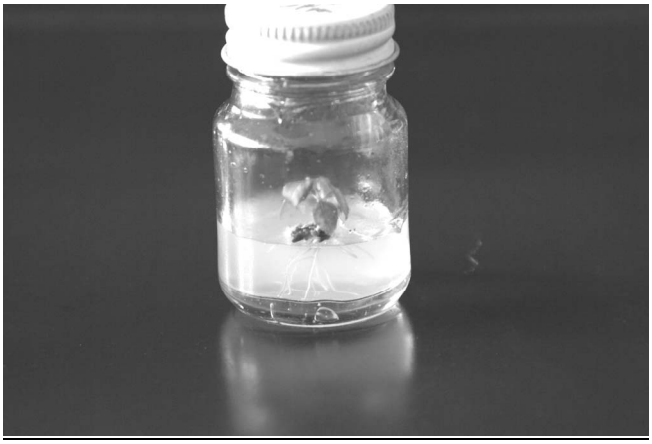

Figure 1. Inter-generic hybrid obtained from ovary at 14 days after pollination in MS medium supplemented with 30 g/l sucrose.

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References

Argus, G.W., 1974. An experimental study of hybridization and pollination in *Salix* (willow). Can J. Bot. 52: 1613-1619.

Argus, G.W., 1986. The genus *Salix* (Salicaceae) in the southeastern United States. Syst. Bot. Monogr. 9: 1170.

Asadi, F., Mirzaii Nadooshan, H., Modir Rahamti, A., 2001. Hybridization between native and foreign species of poplars. Pazhohesh o Sazandegi, 53: 46-51.

Bergner, P., 2001. Salix: Willow bark and NSAID. *Medical Herbalism: Materia Medica and Pharmacy*, 3: 2-7.

Confalonieri, M., Balestrazzi, A., Bisoffi, S., Carbonera, D., 2003. *In vitro* culture and genetic engineering of *Populus* spp.: synergy for forest tree improvement. Plant cell, Tissue and Organ Culture, 72: 109-138.

Dickmann, D.I., 2006. Silviculture and biology of short-rotation woody crops intemperate regions: Then and now. Biomass and Bioenergy, 30: 696-705.

Drusilla, R.B., Bertholdsson, N.O., 2000. Phytoremediation of heavy metal contaminated land using Willow: Practical reality or impossibility? 21st Session of the international poplar commission (IPC2000) poplar and willow culture: Meeting the needs of society and the environment, 149p.

FAO, 1972. Poplars and willows, Published under the auspices of the International Poplar Comission, 328p.

Fritz, R.S., Hochwender, C.G., Albrectsen, B.R., Czesak, M.E., 2006. Fitness and genetic architecture of parent and hybrid willows in common gardens. Evolution, 60: 1215-1227.

Hardig, T.M., Brunsfeld, S.J., Fritz, R.S., Morgan, M., Srians, C.M., 2000. Morphological and molecular evidence for hybridization and introgression in a willow (salix) hybrid zone. mol ecol, 9: 9-24.

Heszky, L.E., Simon-Kiss, I., Quang-Binh, D., Kiss, E., Kiss, J., Gyulai, G. 1992. New plant varieties developed by convention and haploid somaclone method. Proceeding of the First Egyption-Italian Symposium on Biothechnology, Assiut. *Egypt Nov*, Pp: 21-23.

Jafari Mofidabadi, A., 2005. Propagation of *Populus caspica* tree through mature ovary culture. *Iranian Journal of Rangelands and Forests Plant Breeding and Genetic Research*, 13: 29-36.

Jafari Mofidabadi, A., 2006: Tissue Culture Techniques in Plant Breeding and Propagation. Shaghayeghe Roosta Press, 160p.

Jafari mofidi, A., Modir Rahmati, A., 2000. Production of *Populus euphratica* Olive. × *p. alba* L. hybrid poplars through ovary and ovule cultures. Plant Genetic Newsletter, 122: 7-13.

Kalagari, M., Jafari MofidAbadi, A., Tabari, M., Hoseini, S.M., 2003. Inter-specific hybridization in *Populus euphratica* Olive. with using *in vitro* embryo rescue. Pazhohesh o Sazandegi, 61: 6-9.

Mingjian, P., Zhongyu, T., Qun, G., Baosong, W., 2000. The potential of willow genetic improvement. 21st Session of the international poplar commission (IPC2000) poplar and willow culture: Meeting the needs of society and the environment, 137p.

Mofidabadi, A.J., Modirrahmati, A.R., Tavesoli, A., 1998. Application of ovary and ovule culture in *Populus alba* L. × *P. euphratica* Olive hybridization. Silvae Genetica, 47: 332-334.

Mosseler, A., Papadopol, C.S., 1989. Seasonal isolation a reproductive barrier among sympatric *Salix* species. Can J. Bot. 67: 2563-2570.

Murashige, T., Skoog, F., 1962. A revised medium for rapid growth and bioassays with tobacco tissue cultures. Physiol. Plant, 15: 473-497.

Orians, C.M., Griffiths, M.E., Roche, L.b., Fritz, R.S., 2000. Phenolic glycosides and condensed tannins in *salix sericea, S. eriophala* and their F1 hybrids: not all hybrids are created equal. Biochem Syst. Ecol. 28: 619-632.

Orians, C.M., Fritz, R.S., 1995. Secondary chemistry of hybrid and parental willows: Phenolic glycosides and condensed tannins in *Salix sericea, S. eriocephala*, and their hybrids. J. Chem. Ecol. 21: 1245-1253.

Sout, A.B., Mckee, R., Shreiner, F., 1927. The breeding of forest trees for pulpwood. N.Y. Bot. Gar. 28: 49-63.

Zenkteler, M., Wojciechowicz, M., Bagniewska-Zadworna, A., Zenkteler, E., Je˙zowski, S., 2005. Intergeneric crossability studies on obtaining hybrids between Salix viminalis and four Populus species, In vivo and in vitro pollination of pistils and the formation of embryos and plantlets. Trees, 19: 638-643.

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