American Journal of Plant Physiology

ISSN 1557-4539

Academic Journals Inc.

www.academicjournals.com

American Journal of Plant Physiology, 4 (1): 52-57, 2009
ISSN 1557-4539

Evaluation of Potassium Humate Effects on Germination, Yield and Yield Components of HPS-II/67 Hybrid True Potato Seeds Under *in vitro* and *in vivo* Conditions

[1]D. Hassanpanah and [2]M. Khodadadi
[1]Agricultural and Natural Resources Research Centre of Ardabil,
P.O. Box 56491-11169, Ardabil, Iran
[2]Seed and Plant Improvement Institute, Karaj, Iran

Abstract: This experiment was done for evaluation the effects of potassium humate on seed germination, yield and yield components and seed planting method to commercial used of F1 true potato seed. This research was conducted in Ardabil (Iran) during 2007 and 2008. HPS-II/67 hybrid seed 3500 were grown after treatment in seven different times by potassium humate (for 6, 12, 18 and 24 h till complete germination in potassium humate solution, till complete germination in water and without using the potassium humate and water as control). Potassium humate was used 40 mL kg^{-1} seed in 2 L of water. Then seeds were transferred to greenhouse and planted in peat mass bed (Biolan). During growth period were measured the traits such as start and seed germination percent and day number from planting till germination in laboratory and greenhouse. Seedlings transferred in 4-5 leaf stages to field. Experimental design was randomized complete blocks with three replications. After harvest, were measured the traits such as tuber number and weight per plant, tuber weight average per plant and tuber yield. Results showed that among different treatments of potassium humate there is significant difference for the tuber number and weight per plant, tuber weight average per plant and tuber yield. The maximum seed germination percent, tuber number and weight per plant, tuber weight average per plant and tuber yield produced in 6 and 12 h treatment by potassium humate. Direct planting of TPS in compare with the planting after seed germination in potassium humate and water caused to increase tuber yield. In this experiment, seed treatment by potassium humate for 6-12 h and seed direct planting in greenhouse percent without seed germination under *in vitro*, caused to increase seed germination percent and tuber yield.

Key words: True potato seed, potassium humate, hybrid, potato

INTRODUCTION

In the present study we have evaluated the effects of potassium humate on seed germination, yield and yield components and seed planting method to commercial used of F1 true potato seed.

In 2007, Iran had 180,000 ha planted field and 5.2 million ton potato producing (FAO, 2008). The potato breeding program, commercial increasing producing of true potato seed F1, produced uniform tuber and high germination percentage have important.

Regarding to some factors such as limitation of genetically variation, excess transportation of the seed tubers cost, pests and diseases transfer from one generation to another and one region to another, the storage high expense in somatic generation (Upadhya *et al*., 1996), the mini-tuber producing under *in vitro* high expense and cheap planted materials benefit, economical maintaining and free of many

Corresponding Author: Davoud Hassanpanah, Agricultural and Natural Resources Research Center of Ardabil, P.O. Box 56491-11169, Iran Tel: 00984518810610-00989144516703 Fax: 00984512663408

diseases like virus diseases and low seed germination percentage and seed yield, to be non-uniformity the produced tubers with the True Potato Seed (TPS) (Hassanpanah *et al*., 2008d), if we can find the suitable way that can increase the seed germination percent, tuber uniform and yield, in 180,000 ha area, this way will be important and includes the economical attention and can be confident and cheap replace as the seed production in country.

TPS is the tiny botanical seed found in the small, tomato-like fruits of the potato plant. One of the major problems in potatoes growth is that the seed tubers planted are often defective because several diseases and pests can be transmitted tubers. Some of these problems could be avoided using TPS (Carputo *et al*., 1996). TPS has been suggested as an alternative seed source for potato production (Engels *et al*., 1994). The potato may be produced directly from TPS by field sowing or transplanting of nursery grown seedlings (Engels *et al*., 1994).

The International Potato Center (CIP) and other agricultural research institutes have also worked to develop the practical utilization of TPS as an alternative seed technology for farmers and has resulted some progresses to overcome to some primary impediments for TPS producing. For example the direct seed plant in field causes often to settlement the weak plants but using of the seedling or producing the mini-tubers in seedlings bed causes to the high yield and better plants standing (Upadhya *et al*., 1996).

Chilver *et al*. (1999) reported that TPS provided an economically viable alternative to clonal seed only in cases where the quality and productivity of clonal seed were exceptionally low. The use of TPS can be economically attractive where disease pressure is high (Almekinder *et al*., 1996).

Further genetic improvement will increase the areas where TPS provides the better and cheaper planting material (Almekinder *et al*., 1996). The advantages TPS are lower seed cost and higher yield. The potential TPS advantages in comparison to traditional seed tubers with respect to storage losses, disease transfer and availability of seed with optimal physiological age are fully exploited only when potatoes are produced directly from TPS (Engels *et al*., 1994). Hybrid TPS technology has gained commercial acceptability for potato production in a number of countries. Reports on potato production from TPS have emphasized that the success of this technology largely depends on the production of high quality TPS at low cost (Upadhya *et al*., 2003).

Humic acid causes to increase yield in potatoes (Salman *et al*., 2005). Humic acid is used to decrease the chemical fertilizers negative effects on soil. Potassium humate is a material with natural origin that extracts from plants and animal remains exist in the bottom of marshes. This material is formed from N, P, K and microelements namely Mo, Cu, Zn, B, Co, Mg (Gadimov *et al*., 2007). Using of potassium humate increased tuber yield under water stress condition (Hassanpanah *et al*., 2008a; Hassanpanah, 2009b), root number (Baraldi *et al*., 1991), chlorophyll content, mini-tuber number and weight per plant (Hassanpanah *et al*., 2008c) and decreased nitrate accumulation in potato tubers (Hassanpanah *et al*., 2007) and decreased of plantlet transplantation from *in vitro* to greenhouse (Hassanpanah *et al*., 2008b).

In this research has evaluated the potassium humate (K-humate) effects on the seed germination percent increasing, yield and yield components, seed planting methods and use of the TPS as commercial, produced tuber from HPS-II/67 hybrid uniformly and possible use from TPS in seed production in Iran.

MATERIALS AND METHODS

In vitro Condition

This study was conducted in Ardabil Province, Iran in 2007. HPS-II/67 hybrid seed 3500 were grown after treatment in seven different times by potassium humate (for 6, 12, 18 and 24 h, till complete germination in potassium humate solution, till complete germination in water and without

using the potassium humate and water as control). Potassium humate was used 40 mL kg^{-1} seed in 2 L of water. During growth period were measured the traits such as start seed germination, seed germination percent and days number from planting till germination in laboratory.

In Greenhouse Condition

Then seeds were transferred to greenhouse and planted with 1 cm depth, 5 cm distances between the rows and 2 cm distances between plants in peat mass bed (Biolan) under 20±2°C temperature (Hassanpanah *et al*., 2008d). Light irrigation was done one day before seedlings transplanting to the field soil. During growth period were measured the traits as start seed germination, seed germination percent and days number from plant till germination in greenhouse.

In Field Condition

Seedlings transported to the field in 4-5 leave stages. This experiment was done as a basis of randomized complete blocks design in three replications. When seedings plating was done, the 1st node of seeding should go below the soil. Seedlings planted in 75 distances between rows and 25 cm distances between plants. Seedlings plating was done in early morning (Hassanpanah *et al*., 2008d). Haulms cutting were done after 90 days. Tubers harvested 10 days after haulm cutting. After harvesting were measured the traits such as tuber number and weight per plant and tuber yield. Analysis of variances, comparison of means and correlation coefficients were calculated between different traits by MSTATC software.

RESULTS AND DISCUSSIONS

Seed germination in treatment with 6, 12 h and control started late in compare with 18 and 24 h in greenhouse but seed germination percentage had high in treatment with 6 and 12 h in compare with 18 and 24 h, control (Table 1).

Results showed that there are significant differences among different treatments of potassium humate, the tuber number and weight per plant, average tuber weight per plant and tuber yield (Table 2).

The maximum seed germination percent, tuber number and weight per plant and tuber yield produced in 6 and 12 h treatment by potassium humate. In this experiment, potassium humate caused to increase 5.44 t ha^{-1} tuber yield, 2.77 tuber number and 102.55 g and tuber weight per plant (Table 3). With increasing the seeds maintaining period in potassium humate solution from 6 and 12 h to 18 and 24 h, tuber number and weight per plant, tuber average weight per plant and tuber yield showed the decline (Table 3).

Table 1: The traits mean of treatment in potassium humate at different times

	Germination start (day)		Germination (%)		No. of days from planting till germination		
Time (h)	Greenhouse	Laboratory	Greenhouse	Laboratory	Greenhouse	Laboratory	Covering (in greenhouse)
6	11	-	90	-	9	-	Excellent
12	11	-	88	-	9	-	Excellent
18	7	-	78	-	13	-	Good
24	9	-	74	-	11	-	Medium
P	11	-	70	-	9	-	Medium
W	-	6	31	84.44	-	12	Weak
C	-	5	15	89.66	-	12	Weak

P: Seed treatment with potassium humate till complete germination; W: Seed treatment with water till complete germination; C: Without using the potassium humate and water (control)

Table 2: ANOVA traits mean of treatment in potassium humate at different times

		MS			
SOV	df	Tuber number per plant	Tuber weight per plant (g)	Average tuber weight per plant (g)	Tuber yield
Rep.	2	0.93	939.24	59.07	5.11
Treatment	6	13.96*	33134.56*	101.628*	132.39*
Error	12	0.28	55.701	22.12	0.96
CV%	-	8.40	6.04	7.33	8.88

*Significant at 5% level of probability

Table 3: The traits mean comparison of treatment in potassium humate at different times

Time (h)	Tuber number per plant	Tuber weight per plant (g)	Average tuber weight per plant (g)	Tuber yield (t ha^{-1})
6	9.46a *	509.0a	53.89c	26.98a
12	8.63a	510.5a	59.31bc	27.05a
18	5.78b	407.6b	70.87ab	21.60b
24	6.07b	392.0b	64.60ab	20.78b
P	4.29c	283.2c	65.27ab	10.12d
W	3.44c	230.0d	69.00a	12.06c
C	6.28b	407.2b	66.26ab	21.58b

±Mean with the same letters in each column does not have significant difference at the 5% probably level according to value of LSD; P: Seed treatment with potassium humate till complete germination; W: Seed treatment with water till complete germination; C: Without using the potassium humate and water (control)

Table 4: Correlation between the traits mean of treatment in potassium humate at different times

Correlation coefficient	Tuber number per plant	Tuber weight per plant	Average tuber weight per plant	Tuber yield
Tuber number	-			
Tuber weight	0.97**	-		
Average tuber weight	0.84*	0.69	-	
Tuber yield	0.93**	0.96**	0.61	-

*and**: Significant at 5 and 1% probably level

Potassium humate causes the seed germination percentage (Bostan *et al*., 2004), seedling growth and shortened the growth period from seed sowing to grafting (Bostan and Islam, 2003) and tuber yield (Hassanpanah *et al*., 2008a; Hassanpanah, 2009b) increased.

Direct planting of TPS and without buds at that time (6 and 12 h treatment) in compare with the planting after seed germination in potassium humate and water caused to increase 15.91 t ha^{-1} tuber yield, 4.09 tuber number and 191.25 g tuber weight per plant (Table 3). To increase the germinated seeds living probably, although the irrigation were done before and after the planting but as a result of the weak seeds and seed late adaptation with environment and environmental stress shock, decreased the germination percentage from 70-90 to 15-30% in greenhouse and produced the weak seedlings that caused to decrease the yield and component yield, finally.

The results of the correlation showed that there are significant and positive relationship in 1% probably level among the studied attributes such as tuber yield with tuber number and weight per plant has (Table 4). With increasing tuber number and weight per plant, increases tuber yield. Hassanpanah *et al*. (2008a) reported significant and positive relationship among the maintained attributes.

CONCLUSION

In this experiment, seed treatment by potassium humate for 6-12 h and direct planting in greenhouse without seed germination under *in vitro*, caused to increase seed germination percent and tuber yield. Also, produced tuber from HPS-II/67 hybrid had high uniformly, round form, fresh and skin yellow color, shallow eye depth, high dry matter and suitable for processing industry.

Thus, use of this experiment results for seed production are the suitable way that can increase the seed germination percent, tuber uniform and yield, in Iran with 180,000 ha area, this way will be important and includes the economical attention.

ACKNOWLEDGMENTS

Thanks to Agricultural Research and Education Organization and Seed and Plant Improvement Institute, Karaj, Iran for financial assistance this study. We would like to thank Mr. Kamal Zunzunwala Bejo Sheetal Seeds company management for producing the HPS-II/67 hybrid.

REFERENCES

Almekinder, C.J.M., A.S. Chilver and H.M. Renia, 1996. Current status of the TPS technology in the world. Potato Res., 39: 289-303.

Baraldi, R., F.F.F. Malavasi, S. Predieri and M. Castagneto, 1991. Effect of potassium humate on apple cv. Golden Delicious cultured *in vitro*. Plant Cell Tissue Organ Culture, 24: 187-191.

Bostan, S.Z. and A. Islam, 2003. Effect of potassium humate on walnut seedling growth. Ataturk Univ., 34: 29-33.

Bostan, S.Z., A. Islam and M. Yilmaz, 2004. Effect of potassium humate on hazelnut seed germination. Proceedings of the V International Congress on Hazelnut, 2004, Acta Horticulturae, pp: 1-1.

Carputo, D., M. Pentimalli and L. Frusciante, 1996. Production and use of seedling tubers from true potato seed (TPS) for potato cultivation in Italy. Potato Res., 39: 3-9.

Chilver, A., T.S. Walker, V.S. Khatana, H. Fano, R. Suherman and A. Rizk, 1999. On Farm Profitability of True Potato Seed (TPS) Utilization Technologies. Int. Potato Center, Lima, PE., pp: 213-219.

Engels, C., J. Schwenkel, B. Sattelmacher and R. El Bedewy, 1994. Potato production from true potato seed (TPS) in Egypt: Effect of the growing season on seedling development, recovery from transplanting and yield. Potato Res., 37: 233-243.

FAO., 2008. International year of the potato 2008. www.Potato2008.org.

Gadimov, A.G., A.N. Ahmedova and R.C. Alieva, 2007. Simbiosis nodules bacteria *Rhizobium leguminosarum* with Peas (*Pisum sativum*) nitrate reductase, salinification and potassium humus. Trans. Inst. Microbiol. Azerbaijan Natl. Acad. Sci. Baku, 4: 158-163.

Hassanpanah, D., E. Gurbanov, A. Gadimov and R. Shahriari, 2007. Reduction of nitrate accumulation in potato by use of potassium humate for human safety. Iran. Biomed. J., 11: 461-461.

Hassanpanah, D., E. Gurbanov, A. Gadimov and R. Shahriari, 2008a. Determination of yield stability in advanced potato cultivars as affected by water deficit and potassium humate in Ardabil region, Iran. Pak. J. Biol. Sci., 15: 1330-1335.

Hassanpanah, D., E. Gurbanov, A. Gadimov and R. Shahriari, 2008b. Shortening transplantation periods of potato plantlets by use of potassium humate and kadostim and their effects on mini-tuber production. Pak. J. Biol. Sci., 15: 1330-1335.

Hassanpanah, D., E. Gurbanov, A. Gadimov and R. Shahriari, 2008c. Effect of potassium humate on production of advanced potato minituber cvs. Proceedings of 14th International Meeting of IHSS, Sept. 14-19, Russia., pp: 655-658.

Hassanpanah, D., H. Hassanabadi, K. Nekshad and M. Hassani, 2008d. Technical Guideline for Principles of Production and Planting of True Potato Seed (TPS). Hafeze Andeshe, USA.

Hassanpanah, D., 2009a. Effects of water deficit and potassium humate on tuber yield and yield component of potato cultivars in Ardabil Region, Iran. Res. J. Environ. Sci., 3: 351-356.

Hassanpanah, D., 2009b. *In vitro* and *in vivo* screening of potato cultivars against water stress by polyethylene glycol and potassium humate. Biotechnol., 8: 132-137.

Salman, S.R., S.D. Abou-Hussein, A.M.R. Abdel-Mawgoud and M.A. El-Nemr, 2005. Fruit yield and quality of watermelon as affected by hybrids and humic acid application. J. Applied Sci. Res., 1: 51-58.

Upadhya, M.D., B. Hardy, P.C. Guar and S.G. Iiantileke, 1996. Production and utilization of the potato seed in Asia. Proceedings of the Inter-Regional Workshop, 1996, International Potato Center, pp: 233-233.

Upadhya, M.D., R. Cabello, R. Falcon and E. Chujoy, 2003. Effects of location and year of production on hybrid true potato seed quality and performance. Acta Hortic., 619: 371-374.