

# OXIDATIVE STRESS EFFECTS ON POTATO YIELD AND ITS COMPOUND ELEMENTS

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**Abstract:** Potato is the major crop in Mongolia after ranking wheat. Planting area covers between 12 and 14 thousand ha with 170-190 thousand tones total yields. It's new challenge for developing new potato variety with tolerant to environmental stresses. Many modern varieties of potatoes are considered to be drought-sensitive. Potato growing in the agro-ecology environment of the country is believed as little risky for dry farming, but weather change during the last years' requests to be reassessed the circumstances. Especially, the coincidence of hot weather frequency and rainfall shortage in July with potato tuber bulking causes the downed harvest. The field experiment was carried out at IPAS in 2018. The trial was conducted to identify oxidative stress effects on potato yield. There were studied 4 cultivars for yield and its compound elements. During the vegetation period were sprayed Gramoxone (Paraquat) with dosage of 0.3 l/ha for purpose of affect plants through oxidative stress at the 3 different development and growth stages including: budding, flowering and tuber bulking. The analysis of variance (ANOVA) was carried out using SPSS computer software version 16.0 with Tukey test.

Stress effect on potato growth stages was decreased yield differed as in budding 45 %; in flowering 18.2 % and tuber bulking 10.2 %. The analysis of variance revealed the total yield was significant ( $P < 0.05$ ) due to main effect of both variety and oxidative stress treatment. The control treatment was recorded significantly higher yield compared with other treatments among varieties. Cultivar Vineta and Bellarose were gave higher tuber yield significantly from other varieties. Potato tuber yield is higher correlated with number of tuber per plant, tuber weight, and number of marketable tuber. The highest potato yield (526 g) obtained at control treatment with cv. Vineta.

**Key words:** potato, variety, yield, tuber number, tuber weight

**Introduction:** Potato (*Solanum tuberosum* L.) is one of the most important agricultural crops in the world. In volume of production, it ranks fourth in the world after maize, rice and wheat, with an estimated production area of 18.9 million hectares (Nazet.al., 2011). Among root crops, potato ranks first in volume produced and consumed, followed by cassava, sweet potato, and yam (FAO, 2004). It is very important cash and food crops in Mongolia especially when grain is depleted from the store and contributed to food security. Estimated volume production is 170-190 thousand tons per year (2017).

Environmental stresses, including extreme temperatures, salinity, drought, and some chemical stresses affect plant growth and productivity in many crop species including potato. The

loss to agricultural and horticultural industries as a result of exposure of plants to adverse environmental conditions is estimated in the billions of dollars annually (Senaratna, 2003). Moisture stress also severely affect potatoes' growth and productivity as documented in reviews by Singh (1969). Water stress during tuber initiation has been reported to reduce tuber set (Lynch and Tai, 1989; Struik and Van Voorst, 1986). Paraquat causes extensive damage to the mitochondria of cells through the production of free radicals and oxidative stress, resulting in the interruption of important biochemical processes and causing cell death.

### Materials and methods

All trails in the field experiment were laid out following the randomized incomplete block design with four replication. Plot size was 0.7 m x 5 m with 40 tubers per treatment. The four potato varieties were used this study. During the growing season 3 different development and growth stages including: budding, flowering and tuber bulking were sprayed Gramoxone with dose of 0.3 l/ha for affect plants by oxidative stress. All other cultural management practices like weeding, row cultivation, hilling up, spraying and irrigation were carried out according to farmers practice. Tuber yield, number of tuber and average tuber weight were recorded at 110 day after planting. The analysis of variance (ANOVA) was carried out using SPSS computer software version 16.0.

### Results and discussion

Tuber yield: The analysis of variance revealed that tuber yield was significant due to main effect of variety and oxidative stress. The highest tuber yield was obtained at cv.Vineta (526 g) in control treatment but statistical none significant with Bella rose. This might be due to genotype of those varieties more tolerant to oxidative stress compared with Elfe and Toscana. Effect of oxidative stress was highly significant influence potato tuber yield ( $P < 0.0001$ ). The variety Elfe had the lowest yield per plant compared with others among the treatment. There was also significant ( $P = 0.031 < 0.05$ ) interaction between variety and treatments.

#### 1. Means for tuber yield as affected by all interaction effect

№	Variety	Control	Treatment of oxidative stress			Variety average
			budding	flowering	Tuber bulking	
1	Bella rose	444	273	389	456	390a
2	Elfe	326	188	232	274	255c
3	Toscana	440	231	335	353	340b
4	Vineta	526	259	464	475	431a
Treatment average		434a	238c	355b	384ab	354
LSD		47.3				
CV %		12.5				

**Average tuber weight:** The analysis of variance revealed that average tuber weight was significant due to main effect of variety and treatment (table 2, 3). Among the treatment, there was significant difference between control and budding treatment. The variety Bella rose had highest average tuber weight which is differed significantly from other varieties.

### 2. Treatments effect on the average tuber weight (g) per plant

	Treatments	N	1	2	3
TukeyHSD <sup>a</sup>	Budding	16	39.9		
	Flowering	16		56.5	
	Tuberbulking	16		62.3	62.3
	Control	4			71.7
	Sig.		1.000	.467	.099

### 3. Variety effect on the average tuber weight (g) per plant

	Variety	N	1	2	3
TukeyHSD <sup>a</sup>	Elfe	13	37.2		
	Toscana	13	37.8		
	Vineta	13		63.7	
	Bellarose	13			78.8
	Sig.		.998	1.000	1.000

**Number of tuber per plant:** The analysis of variance revealed that number of tuber per plant was significant due to main effect of variety and none significant due to oxidative stress treatment. Cultivar Toscana had highest number of tuber among the treatments. It was also significant difference from others.

### 4. Variety effect on the number of tuber per plant

	Variety	N	1	2	3
TukeyHSD <sup>a</sup>	Bellarose	13	4.9		
	Elfe	13		6.7	
	Vineta	13		6.4	
	Toscana	13			8.5
	Sig.		1.000	.998	1.000

## Summary and conclusion

From the current investigation plant tuber yield, average tuber weight, number of tuber per plant was significant difference due to main effect of variety and oxidative stress. The highest tuber yield was obtained at cv.Vineta (526 g) in control treatment but statistical none significant with Bella rose. Oxidative stress effect on potato growth stages was decreased yield differed as in budding 45 %; in flowering 18.2 % and tuber bilking 10.2 % respectively. The variety Vineta and Bellerose are more tolerant to oxidative stress effect compared with other varieties under Mongolian agro ecology.

## References

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## Biography of Authors

Mr.Nyamgerel, who is agronomist and potato breeder at IPAS. He is Head of Potato production division of IPAS. He is conduct on potato research including: potato breeding, variety evaluation and virus free elite seed propagation. He has been working for 17 years in this field.

Ms.Oyun-Erdene works in IPAS as a researcher. She is responsible development of potato breeding initial materials using conventional breeding method and evaluation potato varieties under Mongolian agro ecological condition. She has been working on potato research for 7 years.