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Study of Shade Net Cultivation Compared to Open Field on Yield of Potato Varieties (*Solanum tuberosum* L.)

Sweety Kerketta[1]*, P. S. Rathiya[2], R. Tigga[3], J. K. Tiwari[1], Neelam Chouksey[1] and Deepak Prajapati[1]

[1]Department of Agronomy, Rajmohini Devi College of agriculture and Research Station, Ajirma, Ambikapur, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India
[2]Potato and Temperate Fruit Research Station, Mainpat, Surguja, C.G., India
[3]Krishi Vigyan Kendra, Ambikapur, Chhattisgarh, India

**Corresponding author*

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A B S T R A C T

A field experiment was conducted at the potato research station, Mainpat, Surguja (C.G.) during *Rabi* season 2021-22 with a view to study the "Study of shed net cultivation compared to open field on yield of potato varieties (*Solanum tuberosum* L.)". The field experiment was carried out in split plot design with three replications. The soil of experimental field was sandy clay soil. The investigation, There were the recommended dose of fertilizer NPK kg ha^{-1} was applied at different concentrations in potato with two production system (Main plot) *i.e.*, P_1- Open field and P_2- Shed net house and four potato varieties (Subplot) *i.e.*, V_1-KufriKhyati, V_2-Kufri Lalit, V_3-KufriChipsona- 3, and V_4- True Potato Seed (F_2C_2) which were interaction effect of potato. The yield attributes of potato i.e. number of tubers $plant^{-1}$, fresh weight of tubers $plant^{-1}$ (g), tuberization efficiency (tuber: haulm), grade wise tuber yield *i.e.*<50g, 50-100 g &>100 g, total tuber yield and haulm yield of potato were significantly superior in shade net house growing system (P_2) with Kufri Lalit (V_2) variety. On the basis of above findings, among the different production system P_2(Shed net house) followed by P_1 (Open field) showed the best result for all the parameters. Amongst the different verity V_2 (Kufri Lalit) followed by V_3 (Kufri Chipsona-3) recorded best result for all the parameters. However, interaction effect of variety with production system P_2V_2(Shed net house and Kufri Lalit) followed by P_2V_3(Shed net house and Kufri Chipsona-3) noticed best result for all the treatments of yield parameter.

Introduction

Potato (*Solanum tuberosum* L.) is an annual herbaceous plant grown in every country in the world and it known as "King of vegetables". It has fourth position among the food crops after wheat, rice and maize. Potato has been disseminated throughout the world. Presently, potato is cultivated on the global basis in 19.30 million hectares with a production of 388.19 million tonnes (Anonymous, 2019). The shading of crops results in number of changes on both local microclimate and crop activity. These changes on local microclimate modify CO_2 assimilation and consequently crop

growth and development. Further, under shading nets the air temperature is lower than that of the ambient air, depending on the shading intensity and is negatively associated with the rate of shading and is variably affected by the quality of light filtered through the different colored shade nets (Elad *et al.,* 2007).

Photo-selective, light-dispersive shade nets provide a unique tool that can be further implemented within protected cultivation practices (Shahak *et al.,* 2008).

India is the world's second-largest potato producer country after China. Potato is one of the most important cash crops in India. It is cultivated on an average 2.16 million hectares with a production of 51.30 million tons with productivity of 23.75 tonnes ha^{-1} (Anonymous, 2020a).

Uttar Pradesh is the major potato producing state with a 31.26 % share followed by West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab, and Assam respectively.

It accounts for nearly 3/4 of the area and contributes to 82% of total potato production in the country. The maximum area as well as the production of potato was recorded in Uttar Pradesh than in West Bengal (Anonymous, 2020b).

In Chhattisgarh, potato occupies about 42750 hectares with a production of 614056 tones and a productivity of 14.36 tonnes per hectare. The highest area (6742 ha) and production (93065 tonnes) was recorded in Surguja district followed by Balrampur, Bilaspur and Raigarh districts of Chhattisgarh (Anonymous, 2020c).

Materials and Methods

The field experiment was conducted at Potato & temperate fruit Research station, Mainpat, Surguja (C.G.) during Rabi season 2021-22. Mainpat block is situated on the southern part of Surguja district of Chhattisgarh and is bounded in the west by Lakhanpur and Ambikapur Blocks.

The block area lies between 22.64 and 22.96 N latitudes and 83.15 and 83.49 E longitudes. The experiment was carried out in split plot design with three replications having eight treatment combinations with four varieties assigned in two potato production system.

Each treatment combination was randomly replicated thrice. The texture of soil of experimental field was sandy clay soil. The soil was neutral in reaction, medium in organic carbon, low in nitrogen and medium in phosphorus and potash content.

After proper mixing of compost, first the fertilizers were applied in the furrows. Nitrogen was applied in form of urea as per the treatments and phosphorous was applied @100 kg ha-1 in form of single super phosphate respectively, whereas, potassium is applied @ 120 kg ha-1 in the form of muriate of potash. The recommended dose of fertilizer i.e.150:100:100 NPK kg ha^{-1} was applied.

On the day of planting full dose of phosphorous and potash along with half dose of the total nitrogen were applied as basal and the rest half of nitrogen was applied in two splits doses at 30th days after planting. Five plants were randomly selected and tagged in each plot, excluding the border plants.

Tagging of plants was done 20 days after sowing. Observations were recorded on the tagged plants for the yield attributes.

Results and Discussion

Data pertaining to yield attributes of turmeric influenced by various treatments has been given in table 1.1, 1.2, 1.3 & 1.4.

Among the crop production system, significantly maximum number of tubers $plant^{-1}$ (7.30) and higher fresh weight of tubers $plant^{-1}$ (204.65g) were observed with shade net house growing system (P_2) as compared to open field production system (P_1) during investigation, but tuberization efficiency (tuber: haulm) did not showed significant variation

between shade net house and open field growing system at harvest stage of crop. With respect to varieties, significantly the highest number of tubers plant^{-1} (7.20), maximum fresh weight of tubers plant^{-1} (203.80g) and higher tuberization efficiency (2.59) was observed under Kufri Lalit (V_2) over other varieties *i.e.* KufriKhyati (V_1), Kufri Chipsona-3 (V_3) and True Potato Seed(F_2C_2) (V_4).

The interaction effect between production systems with varieties on tubers plant^{-1} of potato was found non-significant effect, but fresh weight of tubers plant^{-1} and tuberization efficiency was found significant and maximum fresh weight of tubers plant^{-1} (206.00 g) and tuberization efficiency (2.71) was obtained in shade net house growing system with Kufri Lalit (P_2V_2) during investigations.

These results confirm with the findings by Kumar *et al.,* (2004). This can be attributed to the genotypic differences between the cultivars (Joseph *et al.,* 2011). Similar result was also reported by Nair (1999).

Reduction in fruit weight under open might be due to the reduction in the supply of assimilates to developing sink caused by exhaustion through excess respiration (Cockshell *et al.,* 1992).

Among the crop production system, the all grade wise tuber yield *i.e.*100 g (3.18 t ha^{-1}) and total tuber yield (22.94 t ha^{-1}) was recorded significantly higher with shade net house growing system (P_2) as compared to open field production system (P_1).

With respect to varieties, significantly the highest with grade wise tuber yield *i.e.* 100 g (3.65t ha^{-1}) and total tuber yield (25.04 t ha^{-1}) was observed under Kufri Lalit (V_2) over other varieties *i.e.* Kufri Khyati (V_1), Kufri Chipsona-3 (V_3) and True Potato Seed (F_2C_2) (V_4), but tuber grade size >100 g it was found at par with variety Kufri Chipsona-3 (V_3). Whereas the minimum yield with all grade wise tuber *i.e.*100 g and total tuber yield was observed with True Potato Seed(F_2C_2) (V_4).

The interaction effect between production system with varieties on grade wise tuber yield *i.e.*100 g and total tuber yield of potato was found significant variation and obtained maximum total tuber yield (27.71 t ha^{-1}) with shade net house growing system with Kufri Lalit (P_2V_2) during investigations as compared to other production system and varieties combination. These results are in accordance with the findings of Kumar (2000) and Suchindra (2002).

The results estimated that significant difference among different production system, the maximum haulm yield (9.12 t ha^{-1}) were recorded under shade net house production system (P_2) respectively and the minimum haulm yield (8.29 t ha^{-1}) were recorded under open field production system (P_1).

Significant difference among different varieties and the maximum haulm yield were recorded under variety Kufri Lalit (V_2) (9.66 t ha^{-1}) respectively, followed by variety Kufri Chipsona-3 (V_3) (9.33t ha^{-1}) and Kufri Khyati (V_1) (8.75t ha^{-1}) respectively. The minimum haulm yield was recorded under True Potato Seed (F_2C_2) (V_4) (7.08t ha^{-1}) respectively.

The interaction effect of haulm yield between production system and variety was found non-significant differences among the treatments. Similar finding were also reported by Aclan and Quisumbing (1976) in ginger.

High haulm yield of Kufri Lalit was mainly due to more vegetative crop growth, higher synthesis of carbohydrates and translocation (Sarkar *et al.,* 2011).

Yield attributing characters *i.e.* number of tuber plant^{-1}, fresh weight of tuber plant^{-1}, tuberization efficiency was superior in production system P_2 (Shade net house) and variety Kufri Lalit (V_2) as compared to all other treatments.

It also found superior in all grade wise and total yield compared to other production system and varieties.

Table.1 Yield attributing characters of potato as influenced by production system and variety at harvest stage

Treatments	Number of tuber plant^{-1}	Fresh weight of tuber plant^{-1} (g)	Tuberization efficiency (tuber: haulm)
Production System			
P_1= Open field	6.20	198.23	2.48
P_2= Shed net house	7.30	204.65	2.51
SEm±	**0.11**	**0.14**	***0.01***
CD (P=0.05)	**0.69**	**0.82**	**NS**
Varieties			
V_1= KufriKhyati	6.60	200.75	2.40
V_2= Kufri Lalit	7.20	203.80	2.59
V_3= Kufri Chipsona-3	6.80	202.20	2.45
V_4= True Potato Seed(F_2C_2)	6.40	199.00	2.54
SEm±	**0.17**	**0.44**	**0.04**
CD (P=0.05)	**0.52**	**1.35**	**0.11**

Table.2 Fresh weight of tuber plant^{-1} (g) and Tuberization efficiency (tuber: haulm) as influenced by interaction between production system and varieties

Production System / Varieties	Fresh weight of tuber plant^{-1} (g)			Tuberization efficiency (tuber: haulm)		
	P_1- Open field	**P_2–Shade net house**	**Mean**	**P_1- Open field**	**P_2–Shad net house**	**Mean**
V_1-Kufri Khyati	197.00	204.50	**200.75**	2.42	2.39	**2.40**
V_2–Kufri Lalit	201.60	206.00	**203.80**	2.47	2.71	**2.59**
_V_3Kufri Chipsona-3	199.30	205.10	**202.20**	2.43	2.47	**2.45**
V_4– True potato seed (F_2C_2)	195.00	203.00	**199.00**	2.60	2.48	**2.54**
Mean	**198.23**	**204.65**		**2.48**	**2.51**	
	Production system	**Varieties**	**PxV**	**Production system**	**Varieties**	**PxV**
SEm±	**0.14**	**0.44**	**0.62**	**0.01**	**0.04**	**0.05**
CD (P= 0.05)	**0.82**	**1.35**	**1.91**	**0.06**	**0.11**	**0.16**

Table.3 Grade wise and total tuber yield (t ha^{-1}) and haulm yield (t ha^{-1}) of potato as influenced by various production system and varieties

Treatments	Grade wise tuber yield(t ha^{-1})			Total tuber yield (t ha^{-1})	Haulm yield (t ha^{-1})
	<50g	50-100 g	>100g		
Production System					
P_1= Open field	7.33	12.15	2.98	20.48	8.29
P_2= Shed net house	8.93	13.10	3.18	22.94	9.12
SEm±	**0.12**	**0.10**	**0.03**	**0.13**	**0.06**
CD (P=0.05)	**0.71**	**0.59**	**0.16**	**0.82**	**0.39**
Varieties					
V_1= KufriKhyati	7.33	12.75	3.00	21.01	8.75
V_2= Kufri Lalit	10.02	14.00	3.65	25.04	9.66
V_3= Kufri Chipsona-3	8.47	13.10	3.60	22.85	9.33
V_4= True Potato Seed(F_2C_2)	6.70	10.65	2.05	17.94	7.08
SEm±	**0.29**	**0.13**	**0.09**	**0.30**	**0.21**
CD (P=0.05)	**0.90**	**0.39**	**0.27**	**0.94**	**0.63**

Table.4 Total tuber yield (tha^{-1}) as influenced by interaction between production system and varieties

Production System / Varieties	Total tuber yield (t ha^{-1})		
	P_1- Open field	**P_2–Shade net house**	**Mean**
V_1-Kufri Khyati	20.80	21.94	**21.01**
V_2–Kufri Lalit	22.38	27.71	**25.04**
V_3Kufri Chipsona-3	21.86	23.84	**22.85**
V_4– True potato seed (F_2C_2)	17.61	18.28	**17.94**
Mean	**20.48**	**22.94**	
	Production system	**Varieties**	**PxV**
SEm±	**0.13**	**0.30**	**0.43**
CD (P= 0.05)	**0.82**	**0.94**	**1.33**

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