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Response of potato crop to vrikshaayurveda based herbal kunapajala against black scurf and early blight disease

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Potato is susceptible to diseases like early blight and black scurf caused by *Alternaria solani* (Ellis and Martin) and *Rhizoctonia solani* Kuhn, respectively which are known to reduce the quality, yield and price of the tubers. Since ancient times in India, cultivation of plants using fermented liquid organic fertilizers and amendments had been practiced which are well documented in various scriptures and books. One such formulation is the kunapajala mentioned in Vrikshayurveda which was prepared by fermenting animal remains. It was used not only to stimulate plant growth but also protect them from pests and diseases. The potato cultivar Kufri Bahar was used against early blight and black scurf disease under field conditions during the rabi season of 2020-21 at VRC, Pantnagar. The results revealed that 10 per cent solution of KJ2 (50% nettle grass + 50% seasonal local weed based KJ) at 2000 L/ha dose and KJ3 (seasonal weed based KJ) at 1000 L/ha were found effective against black scurf and early blight disease of potato, respectively showing 12.37 and 35.79% reduction disease severity over control, respectively. It was also found that kunapajala treated tubers were statistically at par in terms of germination per cent and tuber yield with the control treatment in which recommended dose of fertiliser was applied suggesting that kunapajala treatment as mentioned above effectively provided the nutrients required by the growing tubers.

Keywords: Black scurf, Early blight, Herbal kunapajala, Potato, Traditional knowledge, Vrikshayurveda

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Potato (*Solanum tuberosum*) is known as the fourth most important crop in the world after rice, wheat and maize. It is regarded as the "food of future" and has high nutritive value containing most of the macro and micro nutrients required by a human body[1,2]. However, a number of bio stresses including diseases such as early blight of potato caused by the pathogen *Alternaria solani* (Ellis and Martin) and black scurf of potato caused by *Rhizoctonia solani* Kuhn hampers the potato production and market value which accounts for annual losses up to 40 per cent and 25 per cent, respectively in India[3,4]. The symptoms of early blight initially appear as a small irregular circular dark brown spot on the lower older leaves which after 4 weeks forms concentric rings providing the characteristic "bull eye" or "target spot" appearance surrounded by a yellow halo and gradually spread to other leaves, stem and even tubers[5,6]. Black scurf in potato is characterized by the presence of black colored hard masses of sclerotia on the tuber which are superficial, irregular in shape and size along with brown-coloured necrotic lesions on the stem and stolon portion (stem canker)[7]. The conventional method of controlling these diseases is through use of fungicides but various studies have suggested that non-judicious use of chemicals leads to ecological imbalance, high residual effect, harm to other non-target organisms, decrease in soil microbial population, development of resistance in the pathogen along with increased input cost. This can be tackled by using an integrated disease management strategy which include several components like mechanical, physical, cultural, biological, chemical and other control measures.

Several studies have reported the importance of organic approaches for improving the yield and management of diseases. One such way is via the use of fermented organic liquid preparation whose description is even found in ancient Indian literature dating back to 1000 AD. Vrikshayurveda (written by Surpala) is an ancient science of plant life of great importance not only for increasing the productivity

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but also dealing with disease and pest in crops[8] "Kunapajala" a Sanskrit word meaning "stinking like a dead body" is also described in it which was generally prepared by fermentation of animal remains like flesh, fat, marrow, etc. The present investigation was conducted to test the efficacy of modified version of Vrikshayurveda based herbal kunapajala (KJ) as suggested by Ayangarya[9] Nene[10]. Based on that methodology at present various type of modified kunapajala were studied and experimented upon which have shown great results. Kunapajala is reported to promote the crop productivity, soil microbial diversity, disease resistance and overall growth parameters of the plant[11-17]. In this regard various types of herbal kunapajala based upon stinging nettle and seasonal weed were prepared and tested for the management of early blight of potato under the field condition.

Materials and Methods

The field experiments were conducted at Vegetable Research Centre of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttarakhand located at 79.3°E longitude, 29°N latitude and 243.84 m above sea level during the *rabi* season of 2020-2021.

The preparation methodology was inspired from traditional way of preparing Kunapajala with slight modifications[8]. In herbal Kunapajala, nettle as well as seasonal weeds were used as key components. Ingredients used for the preparation of kunapajala are being mentioned separately (Table 1). Three types of Kunapajala *i.e*., KJ1, KJ2 and KJ3 were prepared and used during the course of study. Chopped nettle leaves were main component of KJ1 while KJ2 and KJ3 were composed of different combinations of leaves of locally available plants in different

Table 1 — Key ingredients of KJ1, KJ2 and KJ3 Kunapajala formulation

	Ingredients				Quantity
	KJ1	KJ2		KJ3	
Finely chopped	Finally chopped nettle leaves (*Urtica dioica*)	Nettle leaves (*Urtica dioica*)	10 kg	Neem leaves (*Azadirachta indica*)	3 kg
		Neem leaves (*Azadirachta indica*)	2 kg	Bhat leaves (Clerodendron spp)	2 kg
		Bhat leaves (Clerodendron spp)	1 kg	Madar Arka (*Calotropis gigantea*)	2 kg
		Madar Arka (*Calotropis gigantea*)	1 kg	Dhatura leaves (*Datura stramonium*)	2 kg
		Dhatura leaves (*Datura stramonium*)	1 kg	Bale leaves (*Aegle marmelos*)	2 kg
		Bale leaves (*Aegle marmelos*)	1 kg	Castor leaves (*Ricinus communis*)	2 kg
		Castor leaves (*Ricinus communis*)	1 kg	Kaner leaves (*Cascabela thevetia*)	2 kg
		Kaner leaves (*Cascabela thevetia*)	1 kg	Sharifa leaves (*Annona squamosa*)	2 kg
		Sharifa leaves (*Annona squamosa*)	1 kg	Local weeds	3 kg
		Local weeds	1 kg		
Total weight	20 kg		20 kg		20 kg
Water					10 l
Cow urine (old)					10 l
Cow dung (Fresh)					20 kg
Oilcake of Mustard (*Brassica* spp)					2 kg
Jaggery					2 kg
Germinated urd bean *(Vigna mungo)*					2 kg
Raw milk					1 l
Rice husk water					3 kg
Buttermilk (Sour)					2 l
Water extract of 2 cow dung cakes (upla)					4 l

quantities. All these ingredients were mixed thoroughly in a 200-litre non-transparent plastic drum with a lid. Furthermore, water was added to make up the volume to approximately 180 L and stirred properly. The lid was then closed and the product was kept for fermentation under anaerobic conditions. For 20 days the mixture was daily stirred once in the morning and once in evening until the bubble formation stopped marking the completion of fermentation. The final product formed was then filtered and kept as a stock (100% concentration) at a dark place for future use.

Ten days before sowing, enriched manure was prepared by mixing cow dung (approx. 80 kg on fresh weight basis), cow urine (2.5 L), gram flour (1.5 kg), jaggery (1.5 kg) and field soil (50 g). It was then left undisturbed at a dark place so that microbial population could proliferate (2-3 turnings were done in between) and applied at 10% of the recommended traditional FYM dose (25 t/ha). Soil drenching was done @ 800 L/acre and tubers were treated with 10% of kunapajala (KJ1, KJ2 and KJ3) for 20 min and then shade dried for 1-2 h before sowing. Total 5 foliar sprays at 20 days interval along with the irrigation water were applied for all three types of kunapajala *i.e*., at four different doses of 500 L/ha, 1000 L/ha, 1500 L/ha and 2000 L/ha designated as D1, D2, D3 and D4, respectively until the crop was ready for harvest.

The field preparation included all the standard package of practices recommended for potato cultivation with no application of fungicides, insecticides or herbicides, however, only fertilizers were applied on the control treatment. Germination was recorded after 35 days of planting while five leaves of ten plants were tagged in each plot respectively for non-destructive observations and ratings were taken at 60 and 80 days, respectively according to 0-9 disease rating scale recommended for early blight disease rating in potato[18]. After the tubers were harvested, they were washed followed by shade drying and afterwards rated as per the 0-3 rating scale recommended for black scurf of potato[19].

The disease incidence[8] and per cent disease index[20] were calculated by the help of following formulas. In 3x 3 m^2 plot area (6 rows of 3 meter length), total 90 tubers (5 tuber per meter) were taken in one plot.

Disease incidence (%) incidence =

$$\left(\frac{\textit{Number of infected tuber}}{\textit{Total number of tuber}} \times 100\right)$$

PDI =

$$\left(\frac{\Sigma\ \textit{sum of all numerical rating}}{\textit{total number of tubers observed} \times \textit{highest rating number of the class}} \times 100\right)$$

Statistical analysis of all the data was done by ANOVA using RBD through OPSTAT and the comparison of treatments was made by mean of critical difference at a 5 (%) level of significance

Result and Discussion

Effect on germination

The data in Table 2 with respect to per cent germination for this investigation revealed that

Table 2 — Effect of herbal Kunapajala on various attributes in potato

Treatment	Germination per cent	Black scurf				Early blight				Tuber yield (t / ha)	Per cent increase in yield over control
		Disease incidence (%)	Reduction (%) in disease incidence over control	Disease intensity	Reduction (%) in disease intensity over control	Disease intensity (60 DAP)	Reduction (%) in disease intensity over control	Disease intensity(80 DAP)	Reduction (%) in disease intensity over control		
KJ1D1	80.44	61.34	17.43	35.87	11.05	0.96	34.88	12.67	9.99	29.91	1.84
KJ1D2	80.00	70.85	4.63	38.18	5.32	0.96	34.91	11.26	19.99	30.91	5.26
KJ1D3	76.89	71.12	4.27	38.42	4.73	0.81	45.05	11.85	15.79	29.78	1.41
KJ1D4	76.89	69.30	6.72	39.26	2.66	0.73	50.08	10.22	27.36	30.10	2.51
KJ2D1	79.56	64.50	13.18	38.98	3.35	1.03	29.95	12.74	9.47	29.68	1.06
KJ2D2	80.44	58.04	21.87	35.34	12.37	0.81	44.82	10.96	22.09	31.80	8.29
KJ2D3	80.00	61.25	17.56	36.80	8.74	0.74	49.97	10.67	24.20	30.16	2.70
KJ2D4	79.11	62.96	15.25	38.95	3.42	0.67	54.95	9.56	32.08	31.57	7.50
KJ3D1	80.44	61.62	17.06	35.74	11.37	0.89	39.86	11.26	20.00	30.34	3.30
KJ3D2	80.44	68.77	7.43	41.89	Nil	0.96	34.98	10.00	28.95	30.76	4.76
KJ3D3	77.33	73.39	1.22	43.58	Nil	0.74	50.03	9.70	31.05	29.58	0.74
KJ3D4	76.89	72.92	1.84	43.59	Nil	0.59	59.98	9.04	35.79	31.67	7.83
CONTROL	76.89	74.29	0.00	40.33	0.00	1.48	0.00	14.07	0.00	29.37	0.00
C.D.	3.756	3.891	-	4.201	-	0.253	-	2.352	-	2.601	
SE(m)	1.817	1.325	-	1.431	-	0.086	-	0.801	-	0.890	
C.V.	2.811	3.426	-	6.714	-	17.034	-	12.527	-	5.020	

KJ1D1, KJ2D2, KJ3D1 and KJ3D2 treatment recorded the highest germination per cent (80.44%) however, each treatment was statistically at par with the absolute check (76.89%). This infers that kunapajala neither hampers nor enhances the germination of the potato tubers.

Effect on black scurf disease

The data presented for per cent disease incidence in Table 2 revealed that the highest disease index was recorded in the control treatment (74.29%). Meanwhile, the lowest disease incidence was found in KJ2D2 with 58.04% disease incidence, followed by KJ2D3, KJ1D1, KJ3D1, KJ2D4, KJ2D1, KJ3D2 and KJ1D4 which recorded 61.25, 61.34, 61.62, 62.96, 64.50, 68.77 and 69.30% disease incidence, respectively were significantly better than control exhibiting 21.87, 17.56, 17.43, 17.06, 15.25, 13.18, 7.43 and 6.72% reduction of disease incidence over control, respectively. However, the remaining treatments KJ1D2 (70.85%), KJ1D3 (76.36%), KJ3D3 (73.39%) and KJ3D4 (72.92%) were non-significant and statistically at par with the control, thus were not much effective in controlling the disease incidence of black scurf in potato. It was interesting to notice that among the kunapajala treatments, the KJ2 exhibited the best results in checking the disease incidence as it performed significantly better at every dose against black scurf disease of potato.

The data presented for per cent disease index in Table 2 revealed that the least disease index was observed in KJ2D2 treatment (35.34%) followed by KJ3D1 (35.74%) and KJ1D1 (35.87%) which performed significantly better than the control showing 12.37, 11.37, 11.05 and 8.74% reduction in disease index over control, respectively while the rest of the kunapajala treatments KJ2D3, KJ1D2, KJ1D3, KJ2D4, KJ2D1, KJ1D4, KJ3D2, KJ3D3 and KJ3D4 with disease index *viz*., 36.80, 38.18, 38.42, 38.95, 38.98, 39.26, 41.89, 43.58 and 44.10%, respectively were non-significant and statistically at par with the control.

Effect on early blight disease

The data presented for per cent disease index revealed in Table 2 that 60 days after planting, the highest disease index was recorded in the control treatment (1.48%) while the least disease index was observed in KJ3D4 treatment (0.59%) followed by KJ2D4 (0.67%). Further 80 days after planting the highest disease index (14.07%) was found in check treatment followed by KJ2D1 (12.74%) and KJ1D1 (12.67%). Meanwhile, the best result was shown by KJ3D4 (9.04%) followed by KJ2D4 (9.56%) and KJ3D3 (9.70%). It was interesting to note that all the kunapajala treatments *viz*., KJ3D4, KJ2D4, KJ3D3, KJ3D2, KJ1D4, KJ2D3, KJ2D2, KJ3D1 and KJ1D3 significantly controlled the disease with disease index 9.04, 9.56, 9.70, 10.00, 10.22, 10.67, 10.96, 11.26 and 11.26%, respectively showing 35.79, 32.08, 31.05, 28.95, 27.36, 24.20, 22.09, 20.00 and 19.99% reduction of disease index over control except the treatments KJ2D1 KJ1D1 and KJ1D3 which were statistically at par with the control treatment with 12.74, 12.67 and 11.85% disease index showing 9.47, 9.99 and 15.79%, respectively reduction over control.

Similar studies were also conducted in brinjal wherein kunapajala treatment made them less susceptible to diseases[5]. Also, the ingredients in the composition of kunapajala such as nettle grass, neem, bale, etc. are reported to check the pathogen growth and possess a number of antifungal chemical compounds which could have played a pivotal role in suppressing the disease and providing resistance to the plants[21-23].

Effect on tuber yield

The tuber yield data presented in the Table 2 reveals that all the kunapajala treatments were statistically at par with the control (where fertilizers were applied) inferring that there was no significant decrease in terms of yield within the kunapa jala treatments and kunapa jala successfully provided all the nutrients required by the potato crop. These results are in accordance with earlier works who also suggested that kunapa jala significantly boosted various growth parameters[24]. The reason behind this may be that kunapa jala being a liquid formulation reaches to plant root zone faster and since the fats, protein, etc are already broken down into simpler parts due to fermentation, the nutrients easily get available to the plant[25,26] also it stays longer in soil zone and increases microbial population in soil which consistently provide nutrient for longer time[27,28].

Conclusion

The results revealed that all the treatments under herbal kunapajala significantly decreased the disease index of early blight in potato with the best result in KJ3D4 treatment. Meanwhile, KJ2D2 treatment was most effective against the black scurf of potato.

Kunapajala formulations recorded statistically at par germination (%) and tuber yield with the control treatment where synthetic fertilizers were applied. Therefore, kunapajala exhibit potential to lower our dependence on chemicals, switching to eco-friendly farming. However, reproducibility of results on the response of herbal kunapajala to control diseases in potato and in other crops may be ensured by conducting more studies.

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Conflict of Interest

Authors declare that they do not have any conflict of interest.

This is to certify that the reported work in the paper entitled "Response of Vrikshayurveda based herbal kunapajala on tuber yield as well as against black scurf disease and early blight disease of potato" submitted for publication is an original one and has not been submitted for publication elsewhere. We further certify that proper citations to the previously reported work have been given and no data/tables/figures have been quoted verbatim from other publications without giving due acknowledgement and without the permission of the author(s). The consent of all the authors of this paper has been obtained for submitting the paper to the 'Indian Journal of Traditional Knowledge (IJTK)'.

Authors' Contributions

The idea was conceived and developed by STP along with RPS who verified the analytical methods. SS contributed in planning, designing and throughout supervising the experiment. The trial was performed by SA who was assisted by VS in field operations, data collection and data processing. All the authors contributed in result interpretation and findings of the experiment. SA wrote the manuscript with input from all the authors who provided critical feedback and helped shape the manuscript.

References

1 Ayangarya & Valmiki Sreenivasa, Herbal Kunapa, *Asian Agri Hist*, 8 (4) (2004) 315-317.

2 Nene Y L, Kunapajala–a liquid organic manure of antiquity, *Asian Agri Hist*, 10 (4) (2006) 315-21.

3 Camire M E, Kubow S & Donnelly D J, Potatoes and human health, *Crit Rev Food Sci Nutr*, 49 (10) (2009) 823-840.

4 FAOSTAT, Rome, Italy, Production indices: Potatoes, (FAO, Rome), 2020

5 Bansode G M, More S A, Deshmukh M R & Supe V S, Efficacy of sequential sprays of different fungicides against early blight *Alternaria solani* (Ellis and Martin) in potato *Solanum tubrosum* L., *Int J Pharm Biol Sci,* 8 (1) (2018) 11-15.

6 Sharma S, Black Scurf, *A manual on diseases and pest of potato-Tech Bull*, 101 (2015) 11-13.

7 Wharton P & Wood E, Early blight biology and control in potatoes, *University of Idaho, College of Agriculture and Life Sciences, figure,* 1 (2013) 1-5.

8 Ganie S A, Ghani M Y, Nissar Q, Jabeen N, Anjum Q, *et al*., Status and symptomatology of early blight (*Alternaria solani*) of potato (*Solanum tuberosum* L.) in Kashmir valley, *Afr J Agric Res*, 8 (41) (2013) 5104-5115.

9 Tsror L, Biology, epidemiology and management of *Rhizoctonia solani* on potato*, J Phytopathol,* 158 (2010) 649-658.

10 Nene Y L, Scope of organic waste as eco-friendly materials in crop protection. *Indian J Plant Prot*, 35 (2), (2007) 161-167.

11 Kavya S R & Ushakumari K, Effect of organic liquid manure of Kunapajala on growth and yield of bhindi [*Abelmoschus esculentus* (L.) moench.], *Asian Agri Hist*, 40 (3) (2020) 270-274.

12 Naresh R K, Shukla A K, Kumar M, Kumar A, Gupta R K, *et al*., Cowpathy and vedic krishi to empower food and nutritional security and improve soil health: A Review, *J Pharmacogn Phytochem,* 7 (1) (2018) 560-575.

13 Sarkar S, Kundu S S & Ghorai D, Validation of ancient liquid organics- Panchagavya and Kunapajala as plant growth promoters, *Indian J Tradit Know,* 13 (2014) 398-403.

14 Deshmukh R S, Patil N A & Nikam T D, Influence of kunapajala treatment from vrikshyaurveda on leaves of tomato (*Lycopersicon esculentum* L. Cv. Selection 22) and its comparison with conventional farming and organic farming, *IOSR J Pharm*, 2 (5) (2012) 55-63.

15 Kumar P, Deshmukh P S, Kushwaha S R & Kumari S, Effect of terminal drought on biomass production, its partitioning and yield of chickpea genotype, *Ann Agric Sci,* 22 (2001) 408-411.

16 Singh T P, Deshmukh P S & Kushwaha S R, Physiological studies on temperature tolerance in chickpea (*Cicer arietium* L.) genotypes, *Indian J Plant Physiol*, 9 (2004) 294-301.

17 Jani S, Prajapati P K, Harisha C R & Patel B R, Kunapajala a liquid organic manure: preparation and its quality parameters, *World J Pharm Sci*, 6 (8) (2017) 1989-2000.

18 Ali Md N, Chakraborty S & Paramanik A, Enhancing the shelf life of kunapajala and shasyagavya and their effects on Crop Yield, *Int J Bio-resour Stress Manag*, 3 (3) (2012) 289-294.
19 Bhat R V & Vasanti S, Antiquity of the cultivation and use of brinjal in India, *Asian Agrihist,* 12 (3) (2008) 169-178.
20 Wheeler B E J, An introduction to plant diseases, *An introduction to plant diseases,* (1969) 374.
21 Hadizadeh I, Peivastegan B & Kolahi M, Antifungal activity of Nettle (*Urtica dioica* L.), Colocynth (*Citrullus colocynthis* L. Schrad), Oleander *(Nerium oleander* L.) and Konar (*Ziziphus spina*-christi L.) extracts on plants pathogenic fungi, *Pak J Biol Sci*, 12 (1) (2009) 58-63.
22 Nabrdalik M & Grata K, Assessment of antifungal activity of extracts from nettle (*Urtica dioica* L.) against *Alternaria solani*, *Proceedings of ECOpole*, (2015) 9.
23 Kasarkar A R, Kulkarni D K & Salokhe S P, Phytochemicals investigated in daspharni ark, *Int J Agric Biol,* 3 (1) (2021) 48-51.
24 Ankad G M, Hiremath J, Patil R T, Pramod H J & Hegde H V, Evaluation of Kunapajala and panchagavya on plant quality, physiology, biochemistry, yield and growth attributes–A case study of *Withania somnifera* Dun., *J Ayur Integr Med*, 8 (4) (2017) 247-251.
25 Boer R De, Control of black leg, black scurf and other postharvest storage rots of seed potato, In: *Control of post-harvest diseases of potato,* (FAO, Rome), 1996, 1-50.
26 Sadhale N, Surapala's Vrikshayurveda (The science of plant life), Asian Agri-History Foundation. Secunderabad, *Agri-Hist Bull,* (1996) p. 99
27 Neff J C, Chaplin F S & Vitousek P M, Breaks in the cycle: Dissolved organic nitrogen in terrestrial ecosystems, *Front Ecol Environ*, 1 (2003) 205-211.
28 Cooke B M, Jones D G & Kaye B, *The epidemiology of plant diseases* (Vol. 2), (Dordrecht, The Netherlands: Springer), 2006.