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Pankaj NautiyalKrishi Vigyan Kendra, ICAR-
VPKAS, Chinyalisaur,
Uttarkashi, Uttarakhand, India**Ritika Bhaskar**Krishi Vigyan Kendra, ICAR-
VPKAS, Chinyalisaur,
Uttarkashi, Uttarakhand, India**Gaurav Papnai**Krishi Vigyan Kendra, ICAR-
VPKAS, Chinyalisaur,
Uttarkashi, Uttarakhand, India**Corresponding Author:****Pankaj Nautiyal**Krishi Vigyan Kendra, ICAR-
VPKAS, Chinyalisaur,
Uttarkashi, Uttarakhand, India

Adaptability of wilt resistant variety VL Arhar-1 of pigeon pea under rainfed condition in Uttarkashi district of Uttarakhand

Pankaj Nautiyal, Ritika Bhaskar and Gaurav Papnai

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Abstract

Weather extremes are essential drivers determining the crop's yield, both quantity and quality, and thereby, impacting farmers' income and livelihood. Hill agriculture primarily depends on rainfall and consequently is more vulnerable to adverse impacts of erratic rainfall patterns. To recognize the effect of uncertainties and extremities of rainfall on VL Arhar-1 (Pigeon pea), a study was conducted by Krishi Vigyan Kendra, Chinyalisaur under NICRA project in adopted villages of Block Dunda and Bharkhot of District Uttarkashi, Uttarakhand. The aim was to promote climate resilient practices by introducing short duration and wilt resistant Pigeon pea variety in mainstream pulse cultivation of the district. Observing the lack of irrigation facilities and uneven rainfall for a long period in the area VL Arhar-1 was introduced among the farmers with rationale of not only enhancing the yield but also reduces the risk of protein malnutrition. After sequence of demonstrations and year wise data collection, VL Arhar-1 was found to perform better in terms of yield and economic returns as compared to traditional wild race, popularized as *Tur* among locals.

Keywords: Climate resilient, drought tolerant, impact, NICRA, Uttarakhand, pulses

Introduction

Crop production in hills of Uttarakhand is predominately rainfed, making livelihood of the farming community highly vulnerable. Unexpected rainfalls and its uneven distribution throughout the year not only, causing decline in the production of staple food crops, but also leading to food insecurity, joblessness and migrations of rural youth towards cities for work. Moreover, climate change is expected to worsen the scenario, by more uneven temporal distributions of precipitation (Ram Fishman, 2016) [13] and longer dry spells. Further as per the report of IPCC (2012) [4], that 'the distribution of precipitation events is projected to undergo profound changes... more intense downpours, leading to more floods, yet longer dry periods between rain events, leading to more drought' (Collins M. and Knutti R. 2013) [2], condition will be more grave. Farming communities in hills of Uttarakhand mainly rely on climate sensitive activities like tourism and agriculture, and are therefore unguarded towards climate change. Variations in rainfall not only affect the total crop yield but also increase the incidents of insects & pest and affect soil fertility (Kashaigili *et al.*, 2014, Kurukulasuriya and Rosenthal 2013 and Olesen *et al.*, 2011) [6, 9, 10].

Food insecurity and malnutrition among the community are not separate issues. As reported by Kinda & Badolo, 2019 [7], that rainfall variability reduces food security by reducing food availability per capita and contributes to higher percent of undernourished population in a community. Uncertainty in rainfall patterns are affecting agriculture productivity (Ahmad *et al.*, 2018; Rahman *et al.*, 2018) [1, 12] and ultimately impacting yield. The climate change crisis and weather phenomenon are problems of long run with impacts much longer, therefore, small variations in production methods like cultivation techniques, new resistant and high yielding varieties are best course of action to get quick results. Farmers from hilly regions shares very small land holding, which is challenging in terms of introduction of advanced contemporary scientific techniques to the farmers' field. Moreover, the ugly side of climate change has started reviling itself in form of diversified weather changes, among which unequal and erratic rainfall plays major role in deciding the final crop produce. Frequent floods and severe rains have led to washing away of fertile land (Ghosh *et al.*, 2016; Kumar *et al.*, 2015) [3, 8].

Considering rainfall water as the main source for irrigation and problem of water scarcity due to long dry spells in the drought affected villages in hills, farming has become more difficult than ever, and sometimes resulting in complete crop failure. New released varieties of some pulses are reported to utilize of water efficiently (more specifically unequal rainfall distribution throughout the year) as compare to wild races of the same pulse crop, popular

under cultivation among the rural farming communities. Keeping in mind this fact, VL Arhar-1 (short duration and wilt resistant variety of Pigeon Pea) was introduced in the adopted villages (under NICRA Project) of district Uttarkashi, Uttarakhand. VL Arhar-1 was distributed among the farmers as replacement of wild race *Tur*, which not only is long duration, but also highly susceptible to wilt. The present study shows the economic benefit and popularity of the VL Arhar-1 among the farming community of district Uttarkashi.

Method & Material

- Crop & Variety:** Pigeon Pea (var. VL Arhar-1)
- Village Selected:** Village 1: Dunda
Village 2: Bharkot

Table 1: Rainfall Pattern in NICRA village since 2011-2019

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average rainfall
Rainfall (mm)	1490.00	1358.95	1474.45	1004.85	939.25	681.35	959.75	1019	953.7	1097.92

Source: All Weather Stations (AWS), KVK, Chinyalisaur, Uttarkashi, Uttarakhand

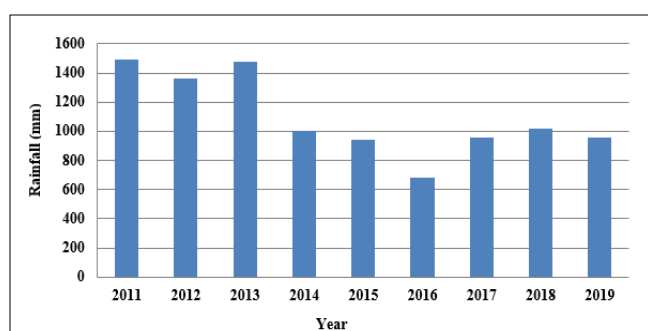


Fig 1: Rainfall pattern observed in the NICRA adopted village

On observing the rainfall trend over the decade (Table 1), it could easily be concluded that there is huge deviation in overall precipitation in the region, consequently affecting the crop productivity. Over the range of yester-years, farmers were cultivating traditional cereals crops and pulses (*Tur* mostly, a wild race of cultivated Arhar) and the income generated from this was not sufficient enough to meet their livelihood. Hence, farmers of these adopted villages were convinced about adopting resilient practices like incorporation of other legumes crops and new varieties (especially wild resistant Arhar) in their on-going cropping pattern which not only will enhance soil fertility but also increase the overall productivity and thus the earnings. Pigeon pea variety 'VL Arhar-1' has shown higher adaptation under diversified

- Rainfall Data:** As represented in Table 1
- Method of Cultivation:** Line Sowing

In Himalayan regions, a large variation has been observed in climatic parameters like increasing temperature and erratic rainfall thus affecting the productivity (Isaac and Isaac., 2017) [5]. The adopted villages, village Dunda and Bharkot (Uttarkashi district) in this experiment receive an average rainfall of 1097.92mm per year and therefore, fall under rainfed agro ecosystem. Acute shortage of water and poor soil health, due to soil erosion are consequents of erratic rainfall deviation. Beside this total annual precipitation is highly variable with altitudes in different parts of the region.

environments under various districts of Uttarakhand, particularly at low and medium elevations (up to 2,000 m above sea level) (Saxena *et al.*, 2011) [14]. On taking into account the erratic rainfall pattern and lack of irrigation facilities in the area of consideration, the wilt resistant variety of pigeon pea (V L Arhar -1) was introduced and promoted to cultivate in the Dunda and Bharkot village in *Kharif* 2011 by KVK Uttarkashi (ICAR-VPKAS). A total of 100 beneficiary farmers were selected purposely from the NICRA villages. Demonstration for VL Arhar-1 was conducted from the year of introduction *i.e.*, 2011 to 2019. Likewise, drought tolerant variety of Finger millet 'VL Mandua 324' was also introduced in the year 2006, as intercropping with VL Arhar-1. The data collection was done on the intervention implemented by the KVK, under NICRA. Impact of the interventions was studied and values of demonstration and check were compared and tested with suitable test statistics.

Result Discussion

Yield Analysis

The results of demonstrations conducted in NICRA adopted village over the nine years (2011- 2019) have given a strong indication of high adaptation of the pigeon pea variety 'VL Arhar-1' in the lower hills of Uttarakhand. Comparing the data on yield basis, it was clearly observed that the demonstrated variety produces higher yield to that of the local variety the farmers used to grow since years.

Table 2: Performance of demonstrated pigeon pea with the local variety

Season	Yield (q/ha)		Increase in yield %
	Local Check (Farmer's variety <i>Tur</i>)	Demo (VL Arhar-1)	
Kharif-2011	9.00	14.50	32.41
Kharif-2012	10.00	15.20	34.21
Kharif-2013	9.30	15.35	39.41
Kharif-2014	11.00	16.58	33.65
Kharif-2015	9.75	18.50	47.29
Kharif-2016	11.00	19.25	42.85
Kharif-2017	10.50	17.50	40.00
Kharif-2018	9.50	18.50	48.65
Kharif-2019	9.50	14.50	34.48
Average	9.95	16.65	39.21

As shown in the table, in initial years of the project, the yield levels of pigeon pea were observed low due to adopting traditional style of farming and poor knowledge of crop

cultivation but in the subsequent years its performance level increases because of timely sowing and better control of diseases and insects due to concentrated efforts of KVK

Uttarkashi. The average yield produced by pigeon pea was higher (16.65 q/ha) in comparison to local check (9.95 q/ha) with the average increase in yield about 39.89%. Crops demonstrated at NICRA farms *viz.*, rainfed crop produces higher yield in comparison to average yield and area before the introduction of NICRA project in Dunda village (Papnai *et al.*, 2017)^[11]. In similar study, it was found that 'VL Arhar-1' produced 2008 kg/ha over four years (2003-2006) and recorded 89.4% yield advantage over the best check 'Manak' (Saxena *et al.*, 2011)^[14].

Table 3: Comparative Economic analysis of pigeon pea with finger millet

Crop	Variety	Average Yield (q/ha)			Net returns (Rs./ha)		BCR	
		Demo	Check	Increase (%)	Demo	Check	Demo	Check
Pigeon Pea	VL Arhar-1	16.65	9.95	39.21	120780	66500	4.83	3.82
Finger millet	VL Mandua 324	20.03	14.3	28.88	23160	16100	2.37	1.78

The economics of other drought tolerant variety of finger millet VL Mandua 324 also fetched more net return (Rs. 23160/ ha) than the local variety/ farmers' practice (Rs. 16100/ha). Similarly the benefit cost ratio for VL Mandua 324 was found as 2.37 which was higher than local check as 1.78. Further, it can also inferred from Table 3 that although the average yield of the finger millet is higher (20.3 q/ha) than the pigeon pea (16.65 q/ha) but the economic benefit is more in case of pigeon pea (Rs. 120780/ ha.) than the finger millet (Rs. 23160/ ha), similar findings were also recoded (Saxena *et al.*, 2011)^[14].

Conclusion

Overall crop productivity in any region is most affected by scarcity and unavailability of water. Pulses crops plays important role in mitigation protein deficiency, especially among the vegetarian populations. On the basis of above results, we can conclude that pigeon pea variety VL Arhar-1 act as drought tolerant and wilt resistant, and is therefore the better choice in the area (NICRA Villages). The data indicated that variety VL Arhar-1 produce more yield compared to traditional varieties (local checks) and therefore, much better monetary returns. On analyzing with drought tolerant crop finger millet, it could be concluded that wilt resistant variety 'VL Arhar-1' can play a potential role in the economic growth of the farming community of rainfed villages of Uttarakhand. Since the variety 'VL Arhar-1' has performed better as rainfed crops under the huge paucity of water and is also compatible in intercropping among the pseudo-cereals like finger millets, the said variety could be promoted and disseminated among the farming community of the hills of Uttarakhand.

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Comparative Economic analysis of pigeon pea with finger millet

The profitability of any crop production system is determined by estimating the cost incurred in producing the crop and the gross returns accrued from it. It was evident from the Table 3 that the average net returns from the pigeon pea (VL Arhar-1) was Rs. 120780/ ha, whereas the farmers practice fetched Rs.66500/ha only. Simultaneously, the benefit cost ratio for VL Arhar-1 (4.83) was significantly higher than local check (3.82).

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