



Official publication of Pakistan Phytopathological Society
Pakistan Journal of Phytopathology

ISSN: 1019-763X (Print), 2305-0284 (Online)

<http://www.pakps.com>



A LANDMARK IN ONION PRODUCTION FOR FOOD SECURITY: WHITE PEARL, A NEW ONION CULTIVAR SUITABLE FOR SOUPS AND SALADS

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ABSTRACT

The current study was designed to introduce the new onion cultivar WHITE PEARL (VRIO-1) it was derived through recurrent selection from a source population. The source population was made and selection was done in the succeeding years based on bulb shape, bulb color, bulb diameter and bulb weight. Same procedure was followed until desired purity is reached. The preliminary evaluation of the variety was conducted during the years 2015-16 at Vegetable Research Institute, Faisalabad. Due to its encouraging yield performance, it was tested in station yield and multilocal/zonal trials during the years 2017-19 at four different locations (Vegetable Research Institute, Faisalabad; Vegetable Research Sub-Station, Raiwind, Vegetable Research Sub-Station, Multan & Regional Agricultural Research Institute, Bahawalpur). The variety WHITE PEARL is distinguishing in terms of bulb shape, bulb diameter and pungency than check variety Phulkara. Bulb colour is white at mature stage, which is quite attractive to the consumers. In case of disease studies no serious pathological disease has been recorded. White Pearl is moderately resistant to diseases like stemphylium leaf blight, downy mildew and purple blotch. Similarly, the check variety Phulkara is also moderately resistant to these diseases. Its shelf life is comparable to check variety Phulkara. This variety is recommended to be used for autumn cultivation as well as cultivation through nursery sets.

Keywords: onion, white pearl, salad, food security and cultivar.

INTRODUCTION

A bulbous crop belonging to the Alliaceae family and genus *Allium*, onions are. This crop is consumed in both its mature bulbs and green form. From Tajikistan, Turkmenistan, to India and Pakistan, which display the most diversity and are thought to be the source, it is more diverse in the eastern Mediterranean countries. (Hange and Sinhasane, 2023). Onion is consumed on daily basis in whole world as bulbs and in condiments. Onion has high medicinal values as it prevents heat stroke and heart diseases and helps to fight against cancer (Pandey *et al.*, 2023). China, with production of 24345 thousand tones is

the largest producer of Onion and 24.87 % share in world production. Pakistan occupies 10th position and 1.87% share in world production (Food and Agriculture Organization, STAT, 2017) (Zheng *et al.*, 2013). In Pakistan Onion is grown on an area of 140839 ha with production 2062336 tones. The yield per unit area of our country is quite low i.e. 14.6t/ha. (Fruit, Vegetable and Condiments Statistics of Pakistan, 2014-15). Global average is 22 t/ha. As Punjab is the most populous province of the county producing only 22 % of total onion production of the county therefore; its onion requirements are fulfilled from the other provinces as well as through import. At present, the local onion production of Punjab province is available only for 3 – 4 months (April, May & June) (Rana *et al.*, 2023). Additionally, Pakistan imported 207.572 tons of onion seeds worth 295.377 million Rupees during the year 2019-20 (Federal Seed Certification and Registration Department, MINFA, Islamabad, 2019-20). Lack of superior quality seed, varieties with high yield

Submitted: August 30, 2023

Revised: November 11, 2023

Accepted for Publication: December 02, 2023

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potential, inadequate availability of labor and water, insect/pest and disease attack and many other factors are responsible of low bulb yield of onion in Pakistan. We are lacking much behind in production so there is a need to increase average bulb yield (Durga *et al.*, 2022).

As a photosensitive crop, onions are divided into long-day, short-day, and intermediate-day varieties based on the amount of photoperiod they need to grow bulbs. Long day types often produce more bulbs per day and need a day length of 14 hours, but short day types only need a day length of 10 to 12 hours and produce fewer bulbs per day (Kumar *et al.*, 2015). There is a need to create plants with high bulb output and long shelf life because long day kinds have limited shelf lives whereas short day types have lengthy ones.

The per unit area low yield is due to non-availability of high yielding and disease resistant varieties well suited for different seasons. Additionally, a few numbers of locally developed varieties are available with the growers and situation is further aggravated due to non-existence of local onion seed industry. Almost total seed requirement is fulfilled from imported seed (Etana *et al.*, 2019).

Normally onion is grown in Rabi season, Nursery is sown in Oct-Nov and transplanted in Dec-Jan and the crop matures in Apr-May. Period of onion bulb availability can be increased through its off-season production in autumn season. For this purpose, nursery sets are produced and used as seed in autumn season (Gent *et al.*, 2004).

Considering the present environmental and seed situation scenario, there is a need to develop onion hybrids and open pollinated varieties possessing suitable characters and yield potential for both (spring and autumn) seasons with fair degree of tolerance against diseases (Aragie *et al.*, 2023). Such hybrids and varieties would also help in extending onion availability period and reduction in onion seed import.

MATERIALS AND METHODS

Site of the experiments: The Vegetable Research Institute in Faisalabad and other locations, such as Pakistan's onion-
Table 1. Performance of WHITE PEARL at VRI, Faisalabad during Rabi 2015-16

Entries	Bulb Weight (g)	Bulb Diameter (cm)	Neck Diameter (cm)	No.of Rings/ Bulb	Yield (t/ha)
Dark red	105.33	4.14	0.93	6.67	12.68
VRIO-5	103.96	4.34	0.68	6.47	11.09
VRIO-1	102.13	4.37	0.91	6.60	10.92
Phulkara (Check)	102.31	4.17	0.84	6.47	10.68
VRIO-4	95.42	4.19	0.95	6.67	10.05
Desi Red	90.89	4.02	0.78	6.20	9.49
LSD (0.05)	1.65	0.56	0.25	1.02	2.01

growing regions, are the locations of all the experiments. The undulating plains of northeast Punjab are where Faisalabad is located. It is 186 meters above sea level and located at 31°25'00" north latitude and 73°04'59" east longitude Faisalabad is known for having high evapotranspiration, which contributes to the city's arid or semiarid climate. In addition to the over 13.417mm of annual rainfall that has been observed, average winter and summer temperatures range from 210°C to 280°C and 300°C to 450°C, respectively. On an annual average, the humidity in Faisalabad, Pakistan, is 35.17 g.m-3(<https://www.weather-atlas.com/en/pakistan/faisalabad-climate#temperature>).

Developmental history: The variety WHITE PEARL was derived through selection from a source population. Once source population was made and then selection was done in the succeeding years based on bulb shape, bulb color, and bulb diameter and bulb weight.

Same procedure was followed until desired purity is reached. The preliminary evaluation of the variety was conducted during the years 2015-16 at Vegetable Research Institute, Faisalabad. Due to its encouraging yield performance, it was tested in station yield and multilocational/zonal trials during the years 2017-19 at four different locations (Vegetable Research Institute, Faisalabad; Vegetable Research Sub-Station, Raiwind, Vegetable Research Sub-Station, Multan & Regional Agricultural Research Institute, Bahawalpur).

To identify genetic variations among the recoded parameters, all the recorded attributes were analyzed using an analysis of variance (Steel and Torrie, 1997). The large variance in yield and yield-related factors may be seen almost everywhere in the morphological parameters.

RESULTS AND DISCUSSION

Yield Performance: The variety WHITE PEARL is being tested since 2015-19 in replicated Varietal Yield Trials and Multilocational/Zonal Trials. The results of these trials are presented below.

YIELD TRIALS: Preliminary Yield Trials:

The variety dark red produces high yield (12.68 t/ha) while white pearl (VRIO-1) produces 10.92 t/ha which is comparable to check variety.

Station Yield Trials:

Table 2. Performance of WHITE PEARL at VRI, Faisalabad during Rabi 2016-17

Entries	Plant Height (cm)	No. of Leaves	Bulb Weight (g)	Bulb Diameter (cm)	Neck Diameter (cm)	No. of Rings	Yield (t/ha)
Dark Red	60.47	17.87	119.33	6.85	1.50	9	21.82
Phulkara (check)	59.20	19.93	111.33	6.96	1.30	10	21.01
VRIO-1	57.47	15.13	116.67	6.69	1.17	9	20.33
Robina	55.40	14.87	118.67	7.05	1.17	9	15.88
VRIO-9	61.93	15.07	109.67	6.43	1.20	9	15.75
Pusa Red	56.73	16.27	120.33	6.53	1.15	9	15.75
VRIO-8	57.67	15.53	115.33	6.38	1.29	9	15.44
LSD (0.05)	2.00	3.90	40.00	0.89	0.20	1.30	1.57

The variety dark red produces high yield (21.82 t/ha) while white pearl (VRIO-1) produces 21.01 t/ha which is comparable to check variety.

Multilocational/Zonal Trials:

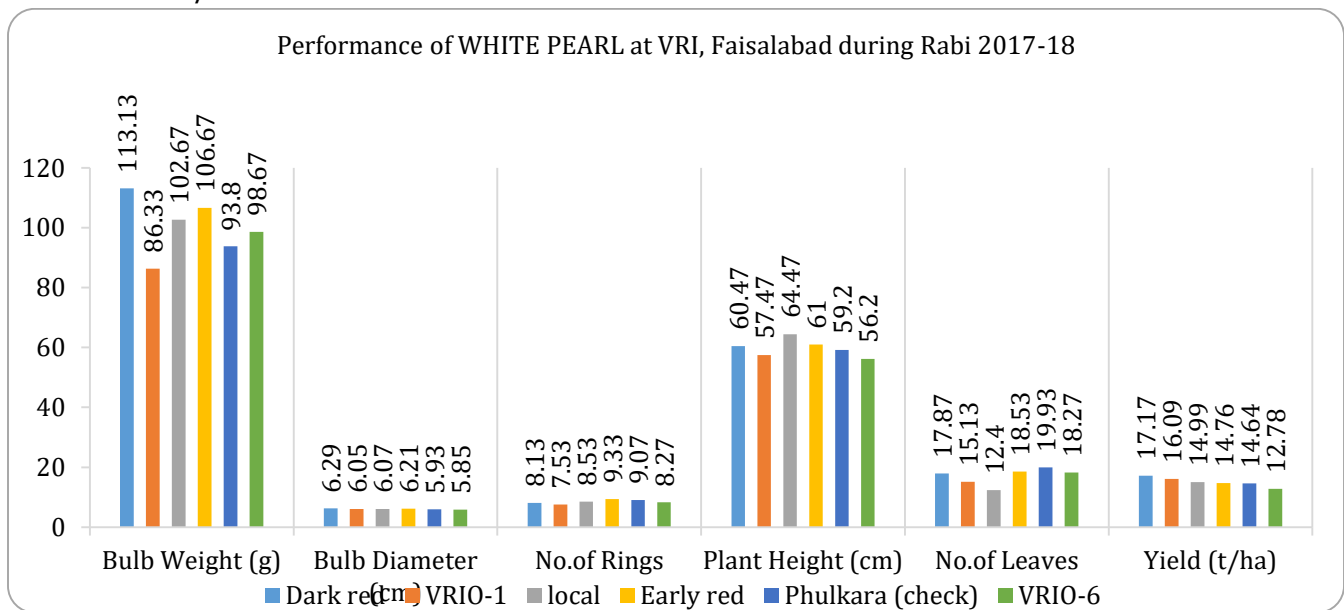


Figure 1. Performance of WHITE PEARL at different locations during Rabi 2017-18

Table 3. Performance of WHITE PEARL at VRI, Faisalabad, VRS Bahawalpur and VRS Multan during Rabi 2017-18

Entries	Bulb Weight (g)			Bulb Diameter (cm)			Neck Diameter			Yield (t/ha)		
	FSD	BWP	MTN	FSD	BWP	MTN	FSD	BWP	MTN	FSD	BWP	MTN
Dark red	113.13	125.67	163.00	6.29	6.29	6.54	8.13	1.28	1.28	17.17	23.73	52.18
VRIO-1	86.33	115.00	151.67	6.05	6.07	6.07	7.53	1.44	1.44	16.09	23.33	49.11
Local	102.67	104.33	141.00	6.07	6.29	6.29	8.53	1.31	1.31	14.99	22.93	46.58
Early red	106.67	94.33	127.67	6.21	5.59	5.57	9.33	1.81	1.56	14.76	22.58	44.09
Phulkara (check)	93.80	87.00	127.00	5.93	5.44	5.44	9.07	1.85	1.85	14.64	21.60	43.82
VRIO-6	98.67	87.67	134.33	5.85	5.57	5.59	8.27	1.56	1.81	12.78	20.98	40.36
LSD (0.05)	24.78	2.90	8.3	0.68	0.50	0.38	1.21	0.45	0.05	1.92	2.01	3.75

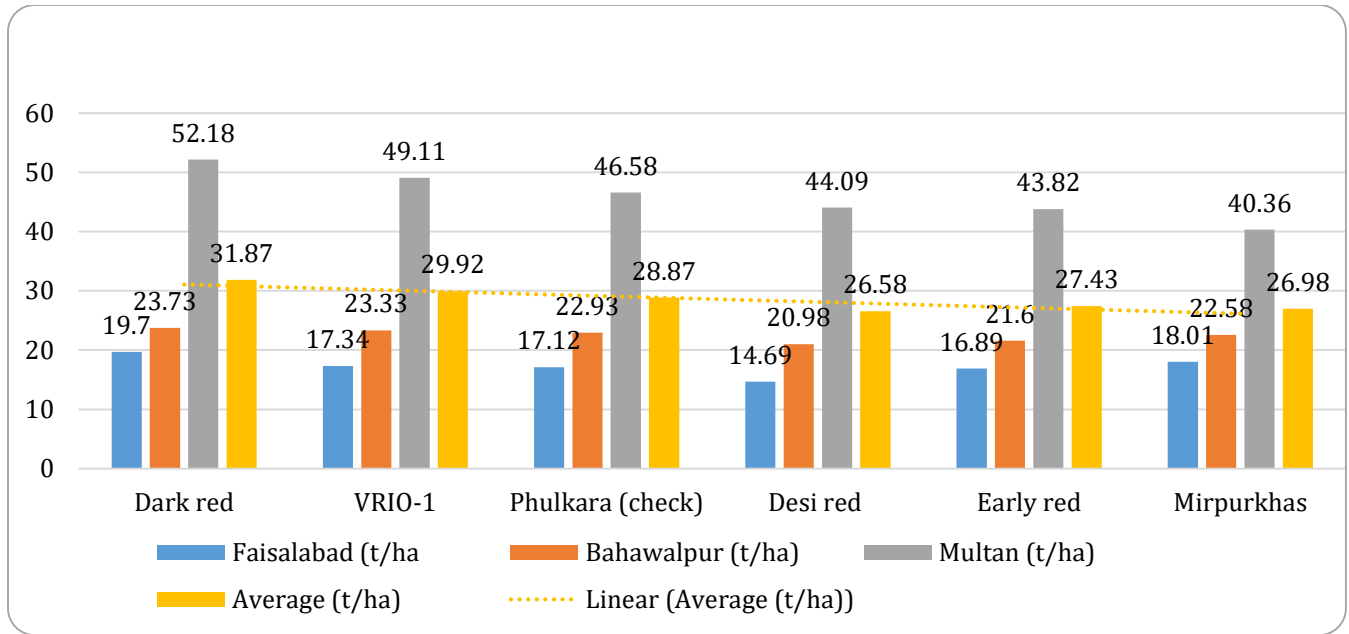


Figure 2. Performance of WHITE PEARL at different locations during Rabi 2017-18

Table 4. Performance of WHITE PEARL at VRI, Faisalabad, VRS Bahawalpur and VRS Multan during Rabi 2018-19

Entries	Bulb Weight (g)			Bulb Diameter (cm)			Neck Diameter			Yield (t/ha)		
	FSD	BWP	RWD	FSD	BWP	RWD	FSD	BWP	RWD	FSD	BWP	RWD
Dark Red	168.00	170.73	169.20	7.77	7.19	6.56	0.99	1.01	1.01	38.40	40.98	40.61
VRIO-1	142.33	156.60	156.47	7.39	7.17	7.15	0.99	0.99	0.99	32.53	37.58	37.55
Phulkara (check)	136.00	146.13	144.80	7.37	6.57	6.50	1.21	1.19	1.19	31.09	35.07	34.75
VRIO-3	133.00	140.53	142.53	7.12	6.53	6.85	0.99	1.33	1.33	30.40	33.73	34.21
VRIO-6	132.33	135.40	130.07	7.39	6.27	6.61	1.01	1.44	1.44	30.25	32.50	31.22
VRIO-4	131.67	113.67	118.73	7.25	5.67	5.75	0.98	1.42	1.42	30.10	27.28	28.50
VRIO-2	122.33	112.67	109.33	7.16	5.45	5.53	0.95	1.38	1.38	27.96	27.04	26.24
LSD (0.05)	22.19	16.70	18.18	0.37	0.34	0.38	0.19	0.17	0.17	5.05	4.00	4.36

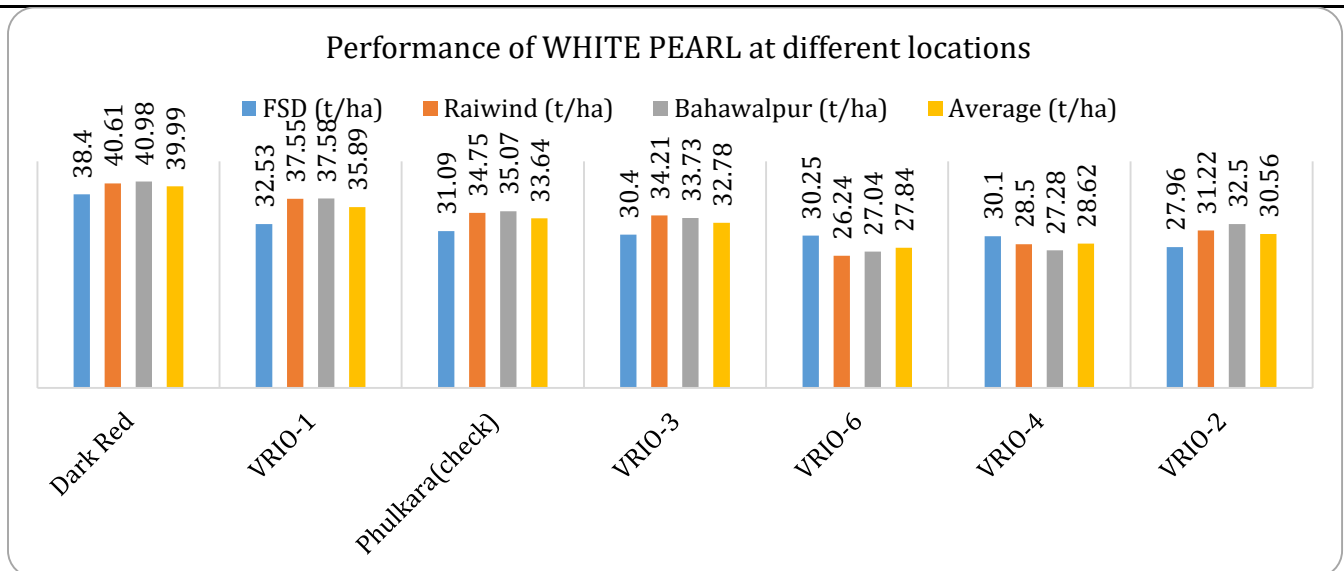


Figure 3. Performance of WHITE PEARL at different locations during Rabi 2018-19

WHITE PEARL is distinguishing in terms of bulb shape, bulb diameter and pungency than check variety Phulkara. Bulb colour is white at mature stage, which is quite attractive to the consumers. It is more suitable to be consumed in fresh form as in salads and soups. Its shelf life is also comparable to check variety Phulkara.

PATHOLOGICAL STUDIES: The pathological studies were carried out by Plant Pathologist, Ayub Agricultural Research Institute, Faisalabad during 2018-19. No serious pathological disease has been recorded so far on variety WHITE PEARL. The details of the results are given below.

Table 5. Disease incidence on WHITE PEARL recorded by Plant Pathologist, Ayub Agricultural Research Institute, Faisalabad during Rabi 2018-19

S. No.	Disease	WHITE PEARL	Phulkara (Check)
1	Stemphylium leaf blight	Moderately Resistant	Moderately Resistant
2	Downy mildew	Moderately Resistant	Moderately Resistant
3	Purple blotch	Moderately Resistant	Moderately Resistant

ENTOMOLOGICAL STUDIES: Entomological Research Institute, Faisalabad, has recorded no serious attack of insect/pest on studied variety. However, negligible attack of thrips were observed.

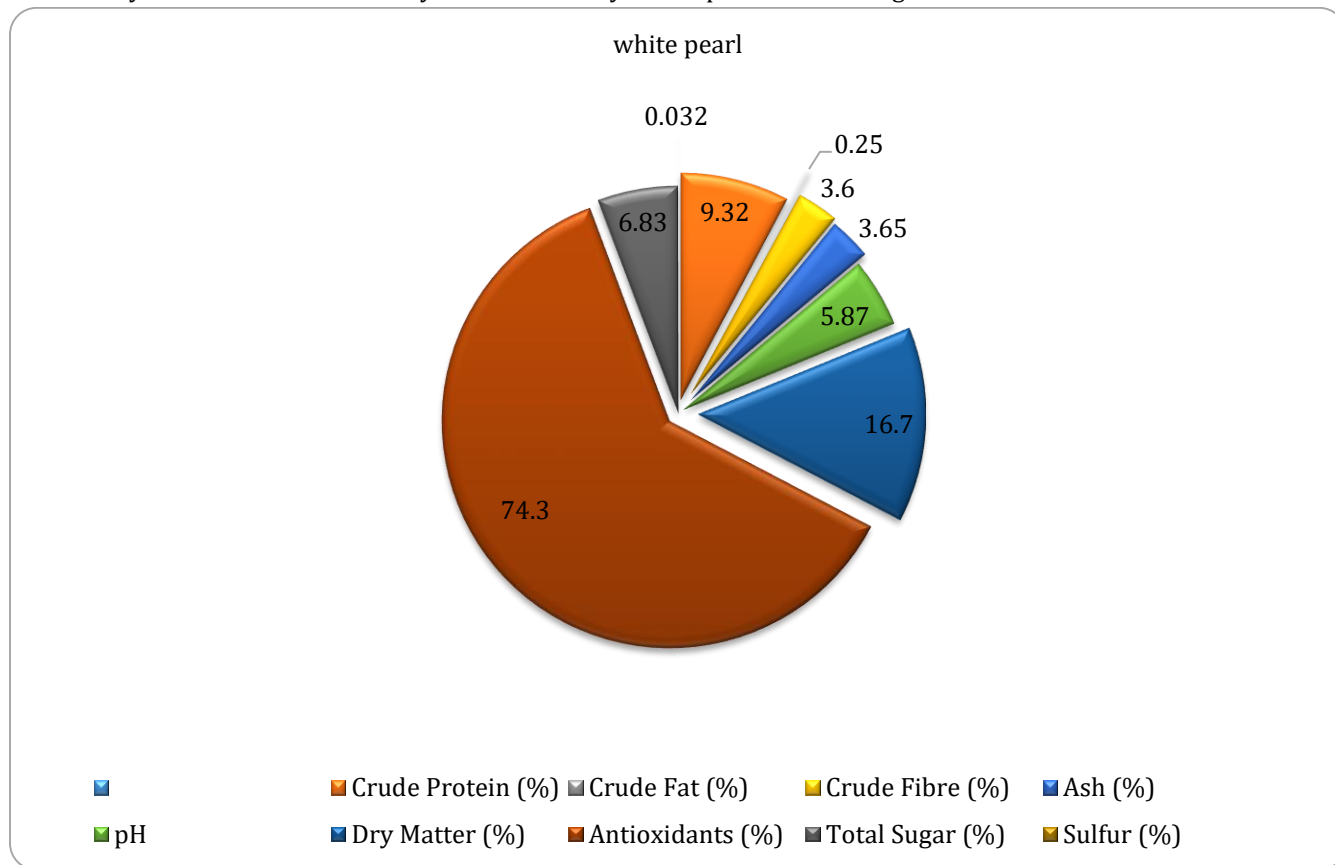
Table 6. Pests infestation data on WHITE PEARL recorded by Entomological Research Institute, AARI, Faisalabad during Rabi 2018-19

Genotype	Thrips Population (%)	Other Insect Pest (%)
Dark Red	6.87	Nil
VRIO-1	5.53	Nil

NUTRITIONAL PROFILE

Nutritional value of the candidate variety was studied by the soil biochemistry section at Ayub

Agricultural Research Institute, Faisalabad during 2018-19 and provide the following results presented in Figure 3.



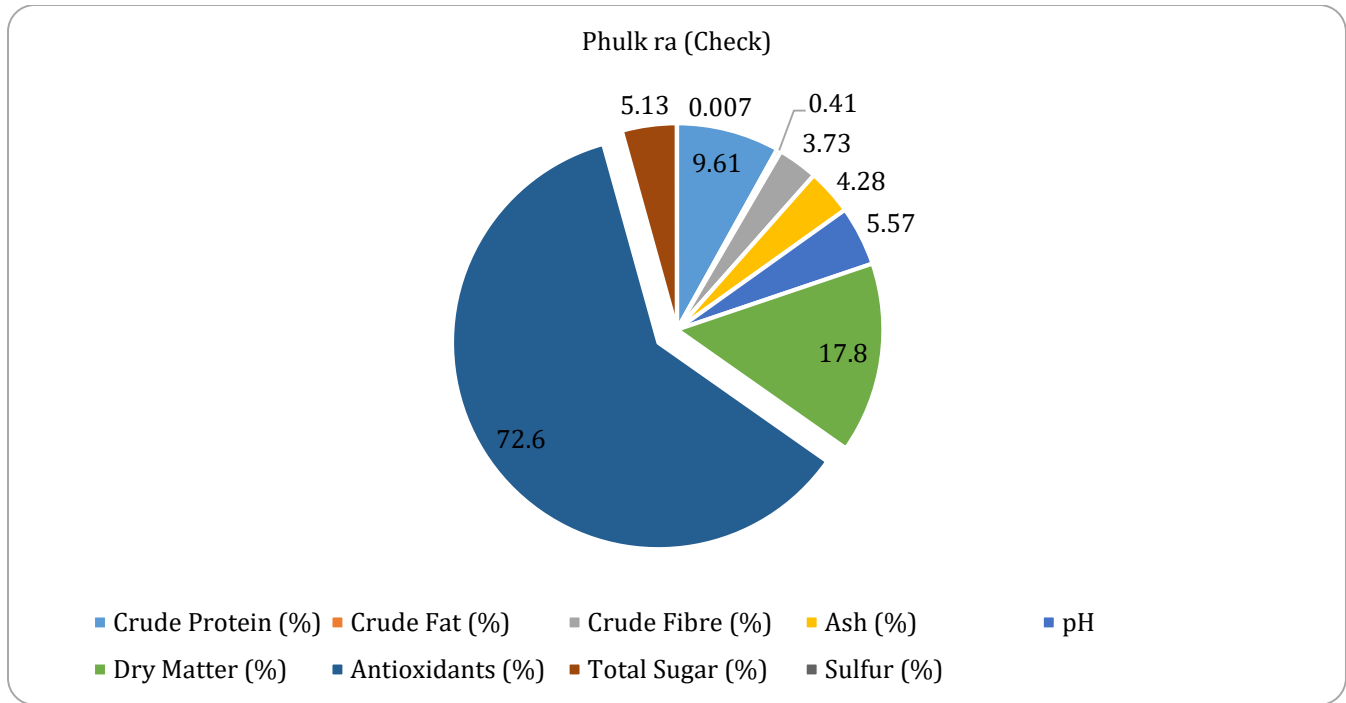


Figure 4. Nutritional profile of WHITE PEARL and Phulkara (Check) studied by soil biochemistry section, AARI, Faisalabad during 2018-19

BOTANICAL DESCRIPTION OF VARIETY “WHITE PEARL: Bulb characters:

White pearl is a medium bulb sized variety, as it is preferred type in Pakistan. Bulb shape is broad ovate with bulb height 5-6 cm and diameter 6-7 cm. It has white skin color with three skin layers and medium adherence. It has greenish white flesh color with medium flesh firmness.

Leaf characteristics: It has medium sized green colored leaf and its leaf attitude is of semi erect type. Leaf length of this variety is 35-40 cm and Leaf width 1.2-1.7cm. It has weak leaf waxiness.

Head characteristics: Head size varies from 7.6-8.1 cm. it has many number of axis. Color of axis at flowering is medium green and color of axis at maturity is straw

Seed characteristics: Seed color is black with angular seed shape its 1000-grain weight is 4g. Its thickness varies from 1.8-2.05 mm

CONCLUSION

WHITE PEARL was tested at Vegetable Research Institute, AARI, and Faisalabad as well as at different onion sowing areas of Pakistan. It is concluded that this latest variety is sweet in taste as compared to other onion varieties and has low pungency. It is more suitable for use in salad and preparation of soups. It has good shelf life due to high dry matter content and it is suitable for cultivation in both growing seasons.

Onion contain a number of antioxidants and sulfur though it has high medicinal value. This variety is also recommended to be used for autumn cultivation as well as cultivation through nursery sets. It is also Resistant to frost and moderately resistant to heat.

ACKNOWLEDGEMENT

WHITE PEARL is a result of continuous, hectic and concerted efforts of a team of scientists of Vegetable Research Institute, Faisalabad who worked wholeheartedly for its planning, selection, screening, yield evaluation, disease screening, entomological studies and final approval.

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Mehvish Tahir	: Data Collection and guide in the write of the paper
Saba Aleem	: Write up of paper graphic presentation of data
Kaiser L. Cheema	: Reviewed the paper
Rasheda Aslam	: Planning and evaluation of the experiment
Nusrat Parveen	: Help out in research experiments, data collection and review
Etlas Amin	: Helped in statistical analysis
Muhammad E. Khan	: Helped in publication and corresponding with Journal
Sadia Kaukab	: Technically evaluated the data and paper