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Seed quality improvement with fruit extracts in blackgram (*Vigna mungo* L.)

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ABSTRACT

The present study was conducted to know the effect of extracts from parts of papaya and pomegranate fruits containing enormous amount of antioxidants on the seed quality parameters of blackgram (*Vigna mungo* L.). Blackgram seeds were soaked in papaya peel, pulp, seeds and pomegranate peel, seeds extracts *viz*., 2.5 %, 5 %, 7.5 % and 10 % concentration for 1 hour. The physiological parameters of soaked seeds were evaluated under laboratory conditions. The results revealed that seeds treated with 2.5 % papaya seed extract recorded high physiological and biochemical changes in terms of field emergence, germination percentage, seedling length, dry matter production, vigour index and α- amylase activity when compared to rest of treatments and control.

KEYWORDS: Seed quality, blackgram, papaya, pomegranate fruit part extracts

INTRODUCTION

Blackgram (*Vigna mungo* L.), the third most important pulse in India, also called urdbean is having a rich source of protein about 26 %. It contributes a major share of protein requirements to the population in India. It is taken as split and also the whole grain and it is crucial for supplement of cereal based diet. It contains approximately 1 - 1.5 % oil, 3.5 - 4.5 % fibre, 4.5 - 5.5 % ash and 62 - 65 % carbohydrates on dry weight basis and also contains folic acid, vitamin B, minerals like iron, calcium, magnesium and potassium.

Seed is an important input in agriculture (quality seed). At harvest, the seeds are of good quality but by the time it reaches the farmers hands, would have deteriorated in quality. Pre-sowing treatment which help in enhancing seed quality like uniform germination, vigour, viability and optimum plant stand in the field. Priming means seeds were partially hydrated so that pre - germinative metabolic mechanisms will be started, then the radicle protrusion will be prevented; at the point seed were dried at original moisture content [1].

Natural antioxidants are rich in fruits and vegetables [2] and the wastes or byproducts are source of potential antioxidants [3]. Papaya (*Carica papaya* L.) belongs to Caricaceae family, and is being considered as a medicinal plant. Papaya contains flavonoids, vitamins, protease inhibitors, alkaloids, saponins, tannins, minerals and carotenoids. Papaya peel contains a high level of proteins, crude fibre, carbohydrate, ash, fat, and rich in potassium, phosphorus and phytochemical composition like total phenols, flavonoids and tannins [4]. Both macro and micro nutrients (Na, Ca, Mg, P, Fe, Cu, Zn, and Mn) are present in the papaya pulp [5]. Papaya seeds contain many biochemicals, glucotropaeolin, benzyl glucosinolates, benzyl isothiocyanate, benzyl thiourea, hentriacontane, ß-sitostrol. Papaya peel and seed extracts contain the high levels antioxidant activity [6].

Pomegranate (*Punica granatum*) belongs to Punicaceae family. It is one of the oldest edible fruits and extensively used in folk medicine. Pomegranate peel contains various types of antioxidant components like polyphenolic class which includes ellagitannins, flavonoids, proanthocyanidin compounds and minerals such as calcium, magnesium, phosphorus, potassium and sodium [7]. Aril contain high amount of polyphenol, organic acids, minerals, vitamins, and sugars [8]. The antioxidant like polyphenols, crude fibres, vitamins, minerals, sugars, the phytoestrogen coumestrol estrones are present in the pomegranate seeds [9-12]. Antioxidants protect and prevent oxidative deterioration of lipids and maintain the structural and functional integrity of cells in seeds [13]. In order to gain a better understanding of the effect of fruit based antioxidants of papaya and pomegranate, on seed invigouration of blackgram, the study was conducted.

MATERIALS AND METHODS

The experiment was conducted to assess the impact of seed treatment with fruit part extracts on physiological parameters of blackgram variety TNAU blackgram CO 6. Genetically pure blackgram seeds variety of CO 6 was procured from Department of Pulses, Tamil Nadu Agricultural University, Coimbatore, which represent the source material for this study. The fruit part extracts of papaya (peel, pulp, seed) and pomegranate (peel, seed) were used for seed treatment, to standardize the optimum concentration of fruits parts extracts. Fruit parts with various concentrations *viz*., 2.5, 5, 7.5 and 10 % of each extract were prepared and seeds were treated and evaluated along with water soaking and nontreated seeds which served as control. Seeds were soaked in the extracts for 1hour in 1:1 ratio of seed to solution (weight: volume). After treatment, the seeds were removed rinsed with water, shade dried at room temperature up to its original moisture content and the following seed quality parameters were assessed.

The germination test was carried out by roll towel method with 8 replications 400 seeds in each treatment [14]. The germination test was conducted in the germination room in which 25±2°C and 95±2 % of temperature and relative humidity (RH), respectively were maintained. At the time of final count root length and shoot length was measured at randomly selected ten healthy seedlings from all replication of every treatment. The selected seedlings are removed without any damage (entire root and shoot) and mean values are expressed in centimeter (cm). For dry matter production, the seedlings selected for the shoot and root length were placed in a paper cover, shade dried for 24 hours and kept at 80 ± 2°C for 24 hours in hot air oven. After cooling in desiccator, weighed and expressed at milligram per 10 seedlings. Vigour index I [15] and Vigour index II [16] were also calculated.

For field emergence, 100 seeds with four replications were sown at flat beds in open field condition. At seventh day end the number of seedlings emerged were counted and expressed in the percentage. The protein content was analyzed by Ali-Khan and Youngs method [17]. α- amylase activity was estimated in the treated seeds and control seeds [18]. The data was analyzed statistically adopting the procedure given by Panse and Sukhatme [19].

Fruit part extraction for seed treatment

Papaya and pomegranate fruits were procured from the orchard of Tamil Nadu Agricultural University, Coimbatore. The fruits were washed with fresh water and the parts were separated; papaya - peel, pulp and seed and also pomegranate - peel and seed. Papaya pulp was used as such without drying because of its higher moisture content. The separated fruit parts of papaya (peel and seed) and pomegranate (peel and seed) were shade dried for 4 – 5 days followed by sun drying for 3 – 5 days. Then dried fruit parts were finely ground by mini dall mill in the Department of Food Process Engineering, Tamil Nadu Agricultural University, Coimbatore. Fruit parts of various concentrations *viz*., 2.5, 5, 7.5 and 10 % were prepared by weight per volume with distilled water. Initially various concentration of peel, pulp and seed of papaya. Peel and seed extracts of pomegranate were evaluated for their performance on improving the seed quality, best treatment were alone where considered for further evaluation.

RESULTS AND DISCUSSION

Seed treated with papaya peel extract at different concentrations showed significant differences in seed germination, root length, shoot length, dry matter, vigour index I and vigour index II. Seeds treated with papaya peel extract at 5 % showed the highest seed germination (77 per cent) when compared to the control (72 per cent) which had the lowest germination per cent. The papaya peel extract 5 % recorded maximum root length (15.2 cm). Papaya peel extract at 5 % and papaya peel 2.5 % showed maximum shoot length (12.6 cm), which was on par with papaya peel 7.5 %. Dry matter (258 mg seedlings^{-10}), vigour index I (2138) and vigour index II (19.87) recorded maximum in papaya peel extract at 5 %. The minimum value obtained in control for all the parameters (Table 1). Papaya peel contains the vitamin c (Ascorbic acid) it plays a major role in seed quality improvement has increased the seed germination percentage [20]. So it may be the reason for increase the seed quality. Similar result was obtained due to Ascorbic acid had increase the seed quality in parsley, onion and pepper seeds [21].

Different concentration of papaya pulp extracts showed significant differences in various physiological parameters of blackgram seeds. The lowest seed germination was recorded in the control 72 per cent, when compared with highest seed germination in papaya pulp extract at 5 % (75 %), which was on par with papaya pulp extract 2.5 % (75 %). The longest root length (15.7 cm), shoot length (12.6 cm) and maximum dry matter (254 mg seedlings^{-10}), vigour index I - 2126 and vigour index II - 19.05 recorded in papaya pulp extract 5 % followed by

Table 1: Effect of seed treatment with papaya peel extract on physiological traits in blackgram

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Dry matter (mg seedlings^{-10})	Vigour index I	Vigour index II
T_1- Control	72 (58.05)	10.8	13.8	237	1771	17.06
T_2- Water soaking	73 (58.70)	11.3	14.3	236	1869	17.23
T_3- Papaya peel extract - 2.5%	75 (60.0)	12.6	14.7	251	2048	18.83
T_4- Papaya peel extract - 5%	77 (61.34)	12.6	15.2	258	2138	19.87
T_5- Papaya peel extract - 7.5%	74 (59.34)	12.3	14.5	249	1985	18.43
T_6- Papaya peel extract - 10%	74 (59.34)	12.0	14.7	241	1978	17.83
Mean	74	11.9	14.5	245	1965	18.21
SEd	0.64	0.21	0.20	0.003	25.00	0.20
CD (P=0.05)	1.35	0.44	0.43	0.006	52.53	0.41

Table 2: Effect of seed treatment with papaya pulp extract on physiological traits in blackgram

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Dry matter (mg seedlings^{-10})	Vigour index I	Vigour index II
T_1- Control	72 (58.05)	10.8	13.8	237	1771	17.06
T_2- Water soaking	73 (58.70)	11.3	14.3	236	1869	17.23
T_3- Papaya pulp extract - 2.5%	75 (60.0)	12.2	14.8	249	2027	18.68
T_4- Papaya pulp extract - 5%	75 (60.0)	12.6	15.7	254	2126	19.05
T_5- Papaya pulp extract - 7.5%	74 (59.34)	11.9	14.3	243	1939	17.98
T_6- Papaya pulp extract - 10%	73 (58.70)	11.5	14.0	231	1862	16.86
Mean	74	11.7	14.5	242	1932	17.81
SEd	0.62	0.12	0.20	0.003	25.26	0.21
CD (P=0.05)	1.30	0.25	0.42	0.006	53.06	0.43

Table 3: Effect of seed treatment with papaya seed extract on physiological traits in blackgram

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Dry matter (mg seedlings^{-10})	Vigour index I	Vigour index II
T_1- Control	72 (58.05)	10.8	13.8	237	1771	17.06
T_2- Water soaking	73 (58.70)	11.3	14.3	236	1869	17.23
T_3- Papaya seed extract - 2.5%	80 (63.44)	13.7	16.8	257	2442	20.56
T_4- Papaya seed extract - 5%	79 (62.73)	12.6	15.4	240	2206	18.96
T_5- Papaya seed extract - 7.5%	75 (60.0)	13.3	15.4	245	2149	18.38
T_6- Papaya seed extract - 10%	75 (60.0)	12.9	15.2	239	2102	17.93
Mean	76	12.4	15.2	242	2090	18.35
SEd	0.89	0.23	0.25	0.004	28.82	0.29
CD (P=0.05)	1.86	0.49	0.52	0.009	60.55	0.61

Table 4: Effect of seed treatment with pomegranate peel extract on physiological traits in blackgram

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Dry matter (mg seedlings^{-10})	Vigour index I	Vigour index II
T_1- Control	72 (58.05)	10.8	13.8	237	1771	17.06
T_2- Water soaking	73 (58.70)	11.3	14.3	236	1869	17.23
T_3- Pomegranate peel extract - 2.5%	74 (59.34)	12.6	14.9	224	2031	16.58
T_4- Pomegranate peel extract - 5%	77 (61.34)	13.3	15.6	245	2224	18.87
T_5- Pomegranate peel extract - 7.5%	79 (62.73)	13.5	15.6	252	2300	19.91
T_6- Pomegranate peel extract - 10%	77 (61.34)	12.9	14.9	233	2141	17.94
Mean	75	12.4	14.9	238	2056	17.93
SEd	0.99	0.07	0.20	0.003	18.61	0.25
CD (P=0.05)	2.08	0.15	0.42	0.006	39.12	0.52

papaya pulp extract 2.5 % all the parameters (Table 2). Papaya pulp is rich source in vitamin C [22]. So, it might be a reason for increasing the seed germination. The same results were obtained in french bean [23], wheat [24], pea [25] and maize [26].

Results from different concentrations of papaya seed extract showed significant variations in seed germination and seedling growth. Papaya seed extract 2.5 % showed 11.1 % in germination, 21.7 % in root length, 26.5 % in shoot length, 8.4 % in dry matter production, 37.9 % in vigour index I and 20.5 % in vigour index II increased over the control (Table 3). Antioxidants protect and prevent oxidative deterioration of lipids [27]. Similarly [28] reported that papaya seeds extracts having strongest DPPH and hydroxyl free radical scavenging activities due to antioxidant properties. So, this may be a reason for the increase in the physiological quality of the blackgram seeds.

Significant differences were noticed in the various concentrations of pomegranate peel extracts on seedling growth. Lower germination (72 %) was observed in control and it was less than 6.5 per cent then the pomegranate peel extract 7.5 % (79 %) (Table 4). This might be due to the proanthocyanidins present in pomegranate peel extracts which are having the capacity to enhancing the seed germination. This is in close conformity with the findings of [7] who stated that pomegranate contains some proanthocyanidins in the peel. It had a positive effect on seed germination due to the enhanced antioxidant efficiency by the seed treating in blackgram.

Significant influence was observed in the different concentration of pomegranate seed extract on physiological traits. The germination percentage of seeds soaked with 2.5 % of pomegranate seed extract (77 %) with an increase of 6.9 % over untreated seed and 5.5 % over water soaked seed. Similar

Table 5: Effect of seed treatment with pomegranate seed extract on physiological traits in blackgram

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Dry matter (mg seedlings^{-10})	Vigour index I	Vigour index II
T_1- Control	72 (58.05)	10.8	13.8	237	1771	17.06
T_2- Water soaking	73 (58.70)	11.3	14.3	236	1869	17.23
T_3- Pomegranate seed extract - 2.5%	77 (61.34)	11.5	15.0	252	2042	19.40
T_4- Pomegranate seed extract - 5%	76 (60.67)	11.2	14.5	249	1953	18.92
T_5- Pomegranate seed extract - 7.5%	74 (59.34)	11.4	14.3	242	1900	17.91
T_6- Pomegranate seed extract - 10%	74 (59.34)	10.5	14.4	231	1840	17.09
Mean	74	11.1	14.4	241	1896	17.94
SEd	0.62	0.20	0.19	0.004	27.54	0.19
CD (P=0.05)	1.30	0.43	0.40	0.008	57.86	0.41

Table 6: Influence of seed treatment with different fruit parts extract on physiological traits in blackgram

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Dry matter (mg seedlings^{-10})	Vigour index I	Vigour index II
T_1- Control	72 (58.05)	10.8	13.8	237	1771	17.06
T_2- Water soaking	73 (58.70)	11.3	14.3	236	1869	17.23
T_3- Papaya peel extract - 5%	77 (61.34)	12.6	15.2	258	2138	19.87
T_4- Papaya pulp extract - 5%	75 (60.0)	12.6	15.7	254	2126	19.05
T_5- Papaya seed extract - 2.5%	80 (63.44)	13.7	16.8	257	2442	20.56
T_6- Pomegranate peel extract - 7.5%	79 (62.73)	13.5	15.6	252	2300	19.91
T_7- Pomegranate seed extract - 2.5%	77 (61.34)	11.5	15.0	252	2042	19.40
Mean	76	12.3	15.2	249	2098	19.01
SEd	0.52	0.19	0.21	0.004	35.09	0.33
CD (P=0.05)	1.08	0.39	0.44	0.008	72.98	0.68

Table 7: Influence of seed treatment on field emergence, protein content and α- amylase activity (mg maltose min^{-1}) of blackgram

Treatment	Field emergence %	Protein content %	α- amylase activity (mg maltose min^{-1})
T_1- Control	68 (55.55)	23.57	0.82
T_2- Water soaking	70 (56.79)	23.64	0.84
T_3- Papaya peel extract - 5%	75 (60.0)	23.90	0.97
T_4- Papaya pulp extract - 5%	72 (58.05)	23.72	0.87
T_5- Papaya seed extract - 2.5%	77 (61.34)	24.09	1.13
T_6- Pomegranate peel extract - 7.5%	75 (60.0)	23.91	1.08
T_7- Pomegranate seed extract - 2.5%	74 (59.34)	23.87	0.91
Mean	73	23.81	0.95
SEd	0.63	0.42	0.01
CD (P=0.05)	1.30	NS	0.03

response was observed in all other parameters, followed by pomegranate seed extracts 5 % (Table 5). Increase in quality of blackgram seeds due to treated with pomegranate seed extracts might be attributed to the presence of vitamin tocopherol and antioxidant [29,30].

The seed soaking with different fruit parts extract had a significant effect on the seed germination, seedling length, dry matter production, vigour index in blackgram. The papaya seed extract 2.5 % highest seed germination and all other parameters. Followed by the pomegranate peel extract 7.5 % and papaya peel extract 5 % (Table 6). Both the fruit parts extract of have higher antioxidant activity and contains the several minerals described by many researchers [4, 29, 31, 32, 33, 34].

Significant differences were noticed in field emergence and α- amylase activity in different fruit extracts. Highest value was observed in papaya seed 2.5 % extract for field emergence (77 %) and α- amylase activity (1.13 mg maltose min^{-1}), followed by pomegranate peel extract 7.5 %, papaya peel extract 5 %, lowest value was observed in control for field emergence (68 %) and α- amylase activity (0.82 mg maltose min^{-1}). There was a non-significant difference in protein content on among the fruit part extracts (Table 7). The enhanced α-amylase enzyme activity in treated seeds may be due to imbibition of seed which increase lead to hydrolysis. The produce α- amylase enzyme was retained even after redrying back to initial moisture content [35]. Similar result was obtained in rice [36].

CONCLUSION

The present study shown that papaya seed extract 2.5 % recorded maximum germination per cent, seedling length, dry matter production and vigour index, followed by pomegranate peel extract 7.5 %, papaya peel extract 5 %. So, we can conclude that the 2.5 % of papaya seed extract can be effectively used for seed treatment in blackgram seed quality improvement.

AUTHOR'S CONTRIBUTIONS

Poovarasan. T designed experiment, interpreted data and writing an original draft. Lakshmi. S participated in the review and editing. Renugadevi. J and Senthil. A for conceptualization, validation of the manuscript.

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