International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 2967-2972

Received: 28-05-2019
Accepted: 30-06-2019

U Tejaswini
Department of Seed Science and Technology, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

SM Prashant
Department of Seed Science and Technology, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

NM Shakuntala
Department of Seed Science and Technology, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

Sangeetha I Macha
Department of Seed Science and Technology, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

D Krishnamurthy
Department of Agronomy, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

LN Yogesh
Department of Genetics and Plant Breeding, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

Correspondence
U Tejaswini
Department of Seed Science and Technology, College of Agriculture, Raichur, University of Agricultural Sciences, Raichur, Karnataka, India

Influence of different seed priming method for enhancing the seed yield in proso millet (*Panicum miliaceum* L.)

U Tejaswini, SM Prashant, NM Shakuntala, Sangeetha I Macha, D Krishnamurthy and LN Yogesh

Abstract
Prosomillet is a small-seeded grassy crop has ability to survive under adverse conditions like limited rainfall, poor soil fertility and land terrain making them an attractive crop for marginal farming environments. The experiment consisted of four priming treatment combinations *viz*., Control, hydropriming, biopriming with *Pseudomonas fluorescens* (20 %) and KH_2PO_4 (2%) with three levels of fertility (100%, 125 % and 150% RDF). Results were maximum in *Pseudomonas fluorscens* @ 20% (P_3), 150% RDF (N_3) and in combination of both *Pseudomonas fluorscens* @ 20% along with 150% RDF (P_3N_3) recorded with plant height 60 DAS (97.56, 95.78 and 99.83 cm), harvest (99.44, 101.18and 99.83 cm), Number of tillers 30 DAS(1.56, 1.50 and 1.67), 60 DAS and harvest (2.22, 2.25 and 2.25), Days to 50 % flowering (32.89, 35.58 and 38.67), Days to maturity (69.22, 69.92 and 70.00), Panicle length (27.78, 26.83 and 26.91 respectively.), panicle weight (33.99, 32.02 and 34.43g respectively.), seed yield (2.4, 1.96 and 2.50 q ha^{-1}), fodder yield (5.78, 4.95 and 6.40 qha^{-1} respectively.), test weight (7.37, 6.48 and 7.62 g respectively.) and economics *viz*., gross returns (62317, 49944 and 65225), net returns (45887, 33873 and 48004) and B:C ratio (3.8, 2.9 and 3.8).

Keywords: Priming, seed yield, economics

Introduction
Prosomillet (*Panicum miliaceum* L.) is commonly known as broomcorn millet, common millet, hog millet, Russian millet and so on, in different parts of the world. Proso millet is currently grown in Asia, Australia, North America, Europe, and Africa (Gavit *et al*., 2017) [10], and used for feeding birds and as livestock feed in the developed countries and for food in some parts of Asia. Proso millet is likely to have originated in Manchuria (Patil *et al.*, 2015) [21], and it is widely grown in temperate climates across the world. It is an important crop in Northwest China and is grown in Kazakhastan, the central and Southern states of India and Eastern Europe, USA, and Australia. It is generally cultivated in the cooler regions of Asia, Eastern Africa, southern Europe, and the United States. Proso millet has adapted well to temperate plains and high altitudes compared to other millets.
Seed is a basic input in agriculture in which 25 % yield increase can be achieved by quality seeds. Quality seed is the key for successful agriculture, which demands each and every seed should be readily germinable and produce a vigorous seedling ensuring higher yield. To provide higher quality seeds, many researchers have developed new technologies called “Seed Enhancement Techniques”.
Priming technique is the need of present time to get the enhanced germination and establishment in order to utilize the soil moisture and solar radiation to a maximum extent. In this way plants would be able to complete their growth before the stresses arrive (Subedi and Ma, 2005) [25]. Osmopriming is commercially used technique for improving seed germination and vigour. It involves controlled imbibition of seeds to start the initial events of germination followed by seed drying up to its original weight. Osmopriming has many advantages including rapid and uniform emergence, improved seedling growth and better stand establishment under any environmental and soil conditions (Chiu and Sung, 2002) [5]. Grain yield was significantly increased in many crops subjected to priming as compared to non-primed crops.

Research on priming has proved that crop seeds primed with water germinated early, root and shoot development started rapidly, grew more vigorously and seedling length was also significantly greater than nonprimed seeds. It could also improve the performance of crop by alleviating the effect of salts under saline soil conditions. Soaking seed in water overnight before sowing can increase the rate of germination and emergence even in soil conditions where moisture content is very low (Clark *et al*., 2001) [4]. Biopriming with *Pseudomonas fluorescens* improves growth of the plants and also induces resistance to downy mildew. Treatment results in enhancement of germination, seedling vigour, plant height, leaf area, tillering capacity, seed weight and yield. And also reduces the time of flowering. (Niranjan *et al*., 2007)

Seed priming is a pre-sowing strategy for improving seedling establishment by modulating pre-germination metabolic activity prior to emergence of the radicle and generally enhances germination rate and plant performance (Mc Donald, 2000) [12].

Effect of integrated nutrient approach on yield and quality of crops is reported by many workers from India and elsewhere in different millets. Nitrogen plays an important role in vegetative growth of plants and finally increases biomass and yield.

Materials and Methods

Treatment Details

Factor-I: Seed priming (P)

P_0 – Control - No priming

P_1 - Hydro priming

P_2 – Seed priming with 20 % *Pseudomonas fluorescens*

P_3 - Seed priming with 2% KH_2PO_4

Factor-II: Nutrient management (N)

N1 – 100% RDF

N2 – 125% RDF

N3 - 150% RDF

Seeds of proso millet cv. HP-4 were soaked in water, 20 % *Pseudomonas fluorescens* and 2% KH_2PO_4 with the seed to solution ratio (w/v) of 1:1 under ambient conditions.

Results and Discussion

All the growth parameters differed significantly due to seed priming. The proso millet seeds primed with KH_2PO_4 (2%) (P_4) recorded highest plant height at 30DAS (62.29 cm) where as in all other growth parameters *Pseudomonas fluorescens* (20%) (P_3) recorded highest plant height and number of tillers (97.56 cm, 99.44cm and 2.22, 2.22) at 60 DAS and at harvest respectively. Days to 50% flowering and days to maturity recorded lower number of days (32.89 and 69.22 respectively) in *Pseudomonas fluorescens* (20%) (P_3). While in control (P_1) recorded lowest (58.86 cm, 91.27 cm and 97.18 cm) and (1.00, 2.00 and 2.00) plant height and number of tillers respectively at 30 DAS, 60 DAS and at harvest. Days to 50% flowering and days to maturity recorded highest number of days (38.89 and 70.00 DAS respectively) in control (P_1).

Increased leaf production due to bio-seed priming might be due to *Pseudomonas fluorescens* (20%) contains physiologically active substances *viz.*, growth regulators and nutrients that promote profuse number of tillers per plant as reported by Sharifi (2011) in Maize. The bio primed agents contain plant growth regulator that promote root growth, increase number of tillers per plant, size of leaves and leaf area duration that contribute better utilization of nutrient and solar radiation causes late senescence of leaf and plant growth.

Plants produced from primed seeds often exhibit a faster growth than unprimed ones. The beneficial impact of priming on plant growth may be due to an improved nutrient use efficiency allowing a higher relative growth rate in Maize (Muhammad *et al*., 2015 in maize) [13]. A higher growth of seedlings observed from primed seeds may also be analyzed in relation to a direct impact of pre-treatment on cell cycle regulation and cell elongation processes (Chen and Arora, 2013) [3]. The growth parameters of chickpea were significantly affected by seed priming (Gupta and Singh, 2012 in chick pea) [7].

The promotion of growth in terms of increase in plant height has been due to increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation. These osmotic driven responses under the influence of gibberellins might have been attributed to increase in photosynthetic activity, accelerated translocation and efficiency of utilizing the photosynthetic products, thus resulting in increased cell elongation and rapid cell division in the growing parts in proso millet. (Turgut *et al*., 2006) [27].

All the growth parameters differed significantly due to nutrient management. The proso millet seeds applied with 150 per cent RDF (N_3) recorded highest (60.85cm, 95.78cm and 101.18 cm) in plant height and highest (1.5, 2.25 and 2.25) number of tillers at 30 DAS, 60 DAS and at harvest respectively. The lower number of days taken to 50% flowering and days to maturity (35.50 and 69.00 respectively) recorded in 100 per cent RDF. While the lowest (58.51 cm, 92.05 cm and 94.74 cm) in plant height (1.17, 2.00 and 2.00) number of tillers was recorded in 100 per cent RDF (N_1) at 30 DAS, 60 DAS and at harvest respectively. Higher number of days to 50% flowering and days to maturity (38.89 and 70.00 DAS respectively) recorded in 150 per cent RDF.

An application of nitrogen provided either through sole source of fertilizer enhanced the plant height of maize across all the stages of crop growth in all the treatments.

Table 1: Influence of seed priming treatments and nutrient management on plant height, number of tillers, days to 50 %flowering and days to maturity in proso millet cv. HP-4

Treatments	Plant height (cm)			Number of tillers			Days to 50% flowering	Days to maturity
	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest		
Priming treatments								
P_1: Control	58.86	91.27	97.18	1.00	2.00	2.00	38.89	70.00
P_2: Hydro priming for 8 h	58.91	94.30	97.30	1.11	2.11	2.11	37.00	69.22
P_3:*Pseudomonas fluroscens* @20%	58.91	97.56	99.44	1.56	2.22	2.22	32.89	69.22
P_4: KH_2PO_4 @ 2 %	62.29	93.08	97.93	1.33	2.11	2.11	33.44	69.78
Mean	59.74	94.05	97.96	1.50	2.11	2.11	35.56	69.55
SEm±	0.137	0.198	0.224	0.172	0.115	0.115	0.168	0.180
CD @5%	0.404	0.585	0.662	0.503	0.336	0.337	0.497	0.533
Nutrient Management								
N_1: 100 % RDF	58.51	92.05	94.74	1.17	2.00	2.00	35.50	69.00
N_2: 125% RDF	59.87	94.33	97.97	1.33	2.08	2.08	35.58	69.75
N_3: 150% RDF	60.85	95.78	101.18	1.50	2.25	2.25	35.58	69.92
Mean	59.74	94.05	97.96	1.33	2.11	2.11	35.55	69.55
SEm±	0.118	0.172	0.194	0.149	0.099	0.099	0.206	0.156
CD @5%	0.350	0.507	0.573	0.436	0.292	0.292	0.428	0.461
P× N (Seed Priming × Nutrient management)								
P_1N_1	58.30	90.37	91.33	1.00	2.00	2.00	38.00	69.67
P_1N_2	58.87	91.43	95.57	1.33	2.00	2.00	39.33	69.67
P_1N_3	59.40	92.00	100.63	1.37	2.00	2.00	39.33	70.00
P_2N_1	58.37	90.57	95.70	1.00	2.33	2.33	33.33	69.33
P_2N_2	60.13	95.73	99.63	1.00	2.00	2.00	36.00	69.67
P_2N_3	60.23	96.60	100.57	1.33	2.00	2.00	36.33	70.00
P_3N_1	58.20	95.43	96.33	1.33	2.33	2.33	32.33	67.67
P_3N_2	58.43	97.40	100.27	1.67	2.33	2.33	33.67	70.00
P_3N_3	60.10	99.83	101.83	1.67	2.00	2.00	38.67	70.00
P_4N_1	61.17	91.83	95.60	1.33	2.33	2.33	32.33	68.33
P_4N_2	62.03	92.73	96.40	1.33	2.00	2.00	32.67	70.00
P_4N_3	63.67	94.67	101.80	1.33	2.00	2.00	33.67	70.33
Mean	59.74	94.08	98.00	1.33	2.11	2.11	35.56	69.55
SEm±	0.237	0.343	0.388	0.297	0.199	0.199	0.292	0.312
CD @ 5%	0.699	1.014	1.147	0.872	0.583	0.583	0.861	0.922

Application of 150 per cent RDF through fertilizer resulted in tallest plant, which were found to be significantly higher than those observed in all other INM treatments. During initial stage the increase in plant height due to levels of N did not caused significant variation. Later on increased plant height might be due to increasing level of nitrogen as it increases cell division, cell elongation and nucleus formation. These results are in line with the findings of Iqbal *et al*., (2015) [6]. Moreover the interaction effect of seed priming and different INM treatments was seen at 100 and 120 DAS during both the years of investigation. The appraised data in Table 1, demonstrated that application of 150 per cent RDF recorded the taller plants in all the methods of seed priming.

All the growth parameters in interaction between seed priming treatments and nutrient management differed significantly. Plant height at 30 DAS KH_2PO_4 along with 150 per cent RDF (P_3N_3) recorded highest (63.67 cm). For rest of all other growth parameters *Pseudomonas fluorescens* (20%) along with 150 per cent RDF (P_3N_3) recorded highest (99.83 and 101.83 cm) plant height at 60 DAS and at harvest and highest (1.67, 2.00 and 2.00) number of tillers at 30 DAS, 60 DAS and at harvest respectively. Lower number of days to 50 per cent flowering and days to maturity (32.33 and 67.67 respectively) recorded in *Pseudomonas fluorescens* (20%) along with 100 per cent RDF (P_3N_1). While the lowest (58.30cm, 90.37 cm and 95.33 cm) plant height 30 DAS, 60 DAS and at harvest and lowest (1.00, 2.00 and 2.00) number of tillers at 30 DAS, 60 DAS and at harvest in control with 100 per cent RDF (P_1N_1) and higher days to 50 per cent flowering and days to maturity (38.00 and 69.97 DAS respectively) was recorded in control along with 150 per cent RDF (P_3N_3).

All the yield parameters differed significantly due to priming treatments. The proso millet seeds treated with *Pseudomonas fluorescens* @ 20 per cent (P_3) noticed highest panicle length (27.78 cm), panicle weight (33.99 g), test weight (7.37 g), seed yield per hectare (2393 kg) and fodder yield per hectare (5783 kg). While the lowest recorded in control (P_1) (24.93 cm, 29.54 g, 6.19 g, 23.93 g, 1.48 kg, 1449 kg and 4173 kg).

The priming with *P. fluorescens* was evident in improving the seed yield and yield attributing factors in pearl millet by Raj *et al.* (2004) [22]. The enhancement in the seedling growth noticed in this study could be attributed to suppressions of deleterious microorganisms and pathogens; production of plant growth regulators such as gibberellins, cytokinins and indole acetic acid, which increased the availability of minerals and other ions and more water uptake (Ramamoorthy *et al.*, 2000) [23].

Significant difference is found for all the yield parameters due to nutrient management. The proso millet seeds applied with 150 % RDF (N_3) recorded highest panicle length (26.83 cm), panicle weight (32.02 g), test weight (6.48 g), seed yield per hectare (1905.00 kg) and fodder yield per hectare (4949 kg). While the lowest recorded in 100% RDF (N_1) (25.40 cm, 31.76 g, 6.46 g, 24.90 g, 1.81 kg, 1788.00 kg and 4648.00 kg).

When, the rate of nitrogen was increased from 0 to 120 and 180 kg N ha^{-1}, the mean hundred kernel weight increased. Increased grain weight with increasing nitrogen levels may be due to the formation of more leaf area which might have intercepted more light and produced more carbohydrates in the source which was probably translocated into the sink the seed and resulted in increased kernel weight than the control. Also, increasing N rates increases the enzyme activity in maize which may result in higher kernel weight. In other words N stress probably disturbed the source and sink relationship Jayashri (2016) [16].

The yield attributes increased significantly with increased fertilizer application. It might be due to assimilation and translocation of more photosynthates towards sink at higher level of fertilizer application. The increasing levels of fertilizers to crops increases photosynthetic rates and translocation of photosynthate to different plant parts and influenced the yield of crops. These results are in confirmity with findings of Dharmendra *et al.* (2018) [9] in chickpea, Tanwar *et al.* (2017) and Jani *et al.* (2015) [15] in chickpea.

It is due to higher dry matter accumulation and effective partitioning of assimilates to the sink, as a result of availability of nitrogen coinciding with physiological needs of the crop. More number of cobs due to high rates of N might be due to the availability of N in proper proportion and improvement in soil structure. Our results are similar to the findings of Khaliq *et al.* (2004) [17] who observed maximum cob per plant in the crop fertilized with 100 kg N ha^{-1} in Maize.

Yield increase may also result from a higher plant density observed as a consequence of priming induced increase in germination percentage (Murungu *et al*., 2004) [20]. Seed priming treatment resulted in increased crop growth rate in treated sets which encouraged deposition of more photo-assimilates in key plant parts, greatly affecting the final yield (Srivastava and Bose, 2012) [24]. Highest grain yield of Pusa Basmati 1121 was obtained with hydro-priming at 60 kg ha^{-1} of N application applied in 3 splits (Mahajan *et al.*, 2011) [18] Binang *et al.*, (2012) [2].

Table 2: The effect of priming and nutrient application on panicle length (cm), Panicle weight (g), test weight (g), seed yield per hectare (kg) and fodder yield per hectare (kg) of proso millet cv. HP-4

Treatments	Panicle length (cm)	Panicle weight (g)	Test weight (g)	Seed yield per ha (kg)	Fodder yield (kg ha^{-1})
Priming treatments					
P_1: Control	24.93	29.54	6.19	1449	4173
P_2: Hydro priming for 8 h	27.06	30.46	6.32	1601	4697
P_3:*Pseudomonas fluroscens* @20%	27.78	33.99	7.37	2393	5783
P_4: KH_2PO_4 @ 2 %	27.22	31.89	6.47	1894	4767
Mean	26.25	30.72	6.58	1834.25	4855
SEm±	0.243	0.143	0.044	22.19	84.98
CD @5%	0.717	0.421	0.131	65.07	249.20
Nutrient management					
N_1: 100 % RDF	25.40	31.38	6.46	1788	4648
N_2: 125% RDF	26.53	31.76	6.47	1809	4668
N_3: 150% RDF	26.83	32.02	6.48	1905	4949
Mean	26.25	31.72	6.58	1834.25	4855
SEm±	0.210	0.123	0.038	19.21	73.60
CD @5%	0.621	0.365	0.113	56.35	215.85
P×N (Seed Priming × Nutrient management)					
P_1N_1	22.94	29.70	5.89	1184	3877
P_1N_2	25.12	30.70	6.24	1546	3938
P_1N_3	26.72	31.22	6.43	1616	4706
P_2N_1	26.20	30.27	6.21	1465	4086
P_2N_2	26.49	30.45	6.34	1578	4343
P_2N_3	26.54	30.64	6.41	1762	5147
P_3N_1	24.93	31.65	7.01	2358	5388
P_3N_2	25.52	33.48	7.38	2360	5559
P_3N_3	26.91	34.43	7.62	2461	6402
P_4N_1	25.72	31.70	6.19	1782	4600
P_4N_2	26.60	32.31	6.26	1931	5002
P_4N_3	26.95	34.01	6.96	1968	5215
Mean	26.25	31.72	6.58	1834	4855
SEm±	0.421	0.247	0.077	22.19	147.19
CD @ 5%	1.242	0.729	0.226	112.71	431.70

also demonstrated that priming had a significant effect on the number of tillers, number of fertile panicles, and consequently grain yield of new NERICA rice varieties.

Turgut *et al.* (2011) determined that biological yield and seed yield increased with nitrogen fertilization in proso millet and that the highest biological yield was obtained from 150kg N ha^{-1} dose, the highest seed yield was obtained from 225kg N ha^{-1} dose. Pointing to the similar results again, Hassan *et al.* (2000) [11] observed that the highest seed yield and fodder yield was in 60kg N ha^{-1} nitrogen dose in foxtail millet (*Panicum italicum*).

Among interaction between different seed priming treatments and nutrient management differed significantly in yield attributes. Seeds treated with *Pseudomonas fluorescens* @ 20 per cent coupled with 150 % RDF (P_3N_3) noticed highest panicle length (26.91 cm), panicle weight (34.43 g), test weight (7.62 g), seed yield per hectare (2461.00kg) and fodder yield per hectare (6402.33 kg). While the lowest in control with 100 % RDF (P_1N_1) recorded (22.94 cm, 29.70 g, 5.89 g, 23.22 g, 1.24 kg, 1184.00 kg and 3877 kg).

Seed priming treatments showed significant difference for economic analysis. Seeds primed with *Pseudomonas fluorescens* (20%) (P_3) recorded highest cost of cultivation (16430.00 Rs ha^{-1}), gross returns (62317.00 Rs ha^{-1}), net returns (45887 Rs ha^{-1}) and B: C ratio (3.8). While the lowest recorded (16280.00 Rs ha^{-1}, 39412.00 Rs ha^{-1}, 23132.00 Rs ha^{-1} and 2.4 respectively) in control (P_1).

Significant difference was observed for economic analysis due to nutrient management. Seeds primed with 150 per cent RDF (N_3) noticed highest cost of cultivation (17071.00 Rs ha^{-1}), gross returns (49944.00 Rs ha^{-1}), net returns (33873.00 Rs ha^{-1}) and B: C ratio (2.9). While the lowest recorded (16795.00 Rs ha^{-1}, 46465.00 Rs ha^{-1}, 31670.00 Rs ha^{-1} and 2.8 respectively) in 100 per cent RDF (N_1)

Economic analysis differed significantly due to interaction effect between seed priming treatments and nutrient management. Seeds primed with *Pseudomonas fluorescens* (20%) along with 150 per cent RDF (P_3N_3) recorded highest cost of cultivation (17221.00 Rs ha^{-1}), gross returns (65225 Rs ha^{-1}), net returns (48004 Rs ha^{-1}) and B: C ratio (3.8). While the lowest recorded (16795 Rs ha^{-1}, 33385.00 Rs ha^{-1}, 16590 Rs ha^{-1} and 2.0 respectively) in control along with 100 per cent RDF (P_1N_1).

Table 3: The effect of priming and nutrient application on cost of cultivation (Rs ha^{-1}) grossreturns (Rs ha^{-1}), net returns (Rs ha^{-1}) and B: C ratio of proso millet cv. HP-4

Treatments	Cost of cultivation (Rs ha^{-1})	Gross Returns (Rs ha^{-1})	Net Returns (Rs ha^{-1})	B:C
Priming treatments				
P_1: Control	16280	39412	23132	2.4
P_2: Hydro priming for 8 h	16280	43762	27482	2.7
P_3: *Pseudomonas fluroscens* (20%)	16430	62317	45887	3.8
P_4: KH_2PO_4 (2 %)	16362	49797	33435	3.0
Mean	-	48822.00	32484	2.8
SEm±	-	20.21	0.526	0.034
CD @ 5%	-	59.28	1.541	0.01
Nutrient management				
N_1: 100 % RDF	16795	46465	31670	2.8
N_2: 125% RDF	16933	47235	32302	2.8
N_3: 150% RDF	17071	49944	33873	2.9
Mean	-	47882	32484	2.8
SEm±	-	17.50	0.46	0.029
CD @ 5%	-	51.34	1.33	0.086
PXN (Seed Priming × Nutrient management)				
P_1N_1	16795	33385	16590	2.0
P_1N_2	16933	40771	23838	2.4
P_1N_3	17071	44093	27021	2.6
P_2N_1	16795	39515	22719	2.4
P_2N_2	16933	42418	25484	2.5
P_2N_3	17071	48121	31050	2.8
P_3N_1	16945	60645	43699	3.6
P_3N_2	17083	61098	44014	3.6
P_3N_3	17221	65225	48004	3.8
P_4N_1	16339	47140	30800	2.9
P_4N_2	17015	51140	34124	3.0
P_4N_3	17153	52404	35250	3.1
Mean	-	48829	32484	2.8
SEm±	-	35.01	0.91	0.06
CD @ 5 %	-	102.68	2.67	0.17

Due to higher seed and fodder yield, the gross returns were maximum in the seed priming treatments. Economic analysis made by Zende *et al.*, (2006) [29] also revealed that 150 per cent RDF proved the maximum gross returns of 201913 ha^{-1} compared to other fertilizer treatments in maize.

The seed priming and fertilizer treatments interacted significantly with respect to seed and fodder production of winter maize on account of improvement in the growth and yield attributes. Among combinations of seed priming and fertilizer practices, bio-seed priming in combination with 150 per cent RDN came out to be significantly superior over rest of the treatment combinations in terms of growth and yield attributes, seed and fodder yield as well as realized the maximum cost of cultivation (28112 ha^{-1}), but compensated with high net returns (58453 ha^{-1}) and fetched highest benefit: cost ratio (3.07) as reported by Jayashri (2016) [16].

Gross returns, net benefits and B: C ratio were higher in seed production of prosomillet. Above results were in correlated with Marer *et al.* (2007) [19] in maize. He reported that higher gross returns, net benefits and B: C ratio might be due to higher complimentarity biological output and more net returns. These results were in confirmity with Vipul Singh *et al.* (2019) [28]. In chickpea and Ahlawat *et al.* (2010) [1]. Chickpea.

Maximum gross returns, net benefits and B: C ratio increased with increase in levels of fertilizer. It might be due to higher cost involvement in the application of fertilizer at higher fertility level without commensurate increase in the seed yield. This result was similar with findings of Vipul Singh *et al.* (2019) [28], Marer *et al.* (2007) [19] and Dhadge *et al.* (2014) [8] in sorghum and chickpea.

Conclusion

Among the different seed priming treatments *Pseudomonas fluorescens* (20%) found to be effective among all other treatments for all seed yield and yield attributes. while for nutrient management treatments, application of 150 per cent RDF found to be superior. Among the interaction of seed priming and nutrient management treatments *Pseudomonas fluorescens* (20%) along with application of 150 per cent RDF found to be better with respect seed yield and yield attribures. The prosomillet seeds treated with *Pseudomonas fluorescens* (20%) along with 150 per cent RDF obtained higher net returns and B: C ratio compared to other treatments.

References

1. Ahlawat IPS, Gangaiah B. Effect of land configuration and irrigation on sole and linseed intercropped chickpea. Indian Journal of Agricultural Science. 2010; 80(3):250-253.
2. Binang WB, Shiyam JQ, Ntia JD. Effect of seed priming method on agronomic performances and cost effectiveness of rainfed, dry-seeded NERICA rice. Research Journal of Seed Science. 2012; 5:136-143.
3. Chen K, Arora R. Priming memory invokes seed stress-tolerance. Environmental and Experimental Botany. 2013; 94:33-45.
4. Clark LJ, Whalley WR, Jones JE, Dent K, Rowse HR, Sawage WEF *et al*. On-farm seed priming in maize: A physiological evaluation. Seventh Eastern and Southern Africa Regional Maize Conference, 2001, 268-278.
5. Chiu KY, Sung JM. Effect of priming temperature on storability of primed sweet corn seed. Crop Science. 2002; 42:1996-2003.
6. Iqbal MA, Ahmad Z, Maqsood Q, Afzal S, Ahmad MM. Optimizing nitrogen level to improve growth and grain yield of spring planted irrigated maize (*Zea mays* L.). Journal of Advances in botany and Zoology. 2015; 2(3):1-4.
7. Gupta V, Singh M. Effect of seed priming and fungicide treatment on chickpea (*Cicer arietinum*) sown at different sowing depths in kandi belt of low altitude sub-tropical zone of Jammu. Applied Biology and Research. 2012; 14:187-92.
8. Dhadge SM, Satpute NR, Kathmale DK, Patil SV, Ravindra Chary G, Srinivasa Rao *et al*. A study on sorghum with varying row proportions on a semiarid vertisol. Indian Journal Dryland Agriculture Research and Development. 2014; 29(2):34-40.
9. Dharmendra M, Chandra B, Anil Shukla, Singh VK Navneet Pareek. Effect of planting patterns and fertility levels in chickpea and linseed intercropping in tarai region of Uttarakhand, India. International Journal Current Microbiology Applied Science. 2018; 7(08):1957-1961.
10. Gavit HD, Rajemahadik VA, Bahure GK, Jadhav MS, Thorat TN, Kasture MC. Effect of establishment techniques and sowing time on yield and yield attributes of proso Millet (*Panicum miliaceum* L.), International Journal Current Microbiology Applied Science. 2017; 6(5):1523-1528.
11. Hassan SME, Rahman MS, Hossain MF, Amin MR, Alam MM. Evaluation of planting density and nitrogen on the performance of Kaon (*Setaria italica* (L). Beauv.), Pakistan Biology of Science. 2000; 3(11):1863-1864.
12. Mc Donald MB. Seed priming In: Black M and Bewley JD (eds). Seed technology and its biological basis, Shelfield Academic press Ltd, 2000, 287-325.
13. Muhammad I, Kolla M, Volker R, Günter N. Impact of nutrient seed priming on germination, seedling development, nutritional status and grain yield of maize. Journal of Plant Nutrition. 2015; 38:1803-1821.
14. Niranjan RS, Shetty NP, Shetty HS. Seed bio-priming with Pseudomonas fluorescens isolates enhances growth of pearl millet plants and induces resistance against downy mildew, International Journal of pest management. 2004; 50(1):41-48.
15. Jani AH, Hossain MA, Karim MM, Hasan AK. Performance of maize–lentil/chickpea intercropping as influenced by row arrangement. International Journal of Sustainable Crop Production. 2015; 10(3):1-7.
16. Jayashri Karmore V. Integrated nitrogen management and Seed priming effects on crop establishment, growth, yield and quality of winter maize (*Zea mays* L.). M.Sc. (Agri.) thesis, UAS, Dharwad in partial fulfillment of the requirement for the degree, 2016.
17. Khaliq T, Mahmood T, Kamal J, Masood A. Effectiveness of farmyard manure, poultry manure and nitrogen for corn (*Zea mays* L.) productivity. International Journal of Agricultural Biology. 2004; 6(2):260-263.
18. Mahajan G, Singh J, Sharma N. Enhancing the performance of direct seeded basmati rice through seed priming and nitrogen management. Indian Journal of Agronomy. 2011; 48:380-82.
19. Marer SB, Lingaraju BS, Shashidhara GB. Productivity and economics of maize under rainfed condition in northern transitional zone of Karnataka. Karnataka Journal of Agricultural Science. 2007; 20(1):1-3.
20. Murungu FS, Chiduza C, Nyamugafa P, Clarck LJ, Whalley WR, Finch-Savage WE. Effect of on-farm seed priming on consecutive daily sowing occasions on the emergence and growth of maize in semi-arid Zimbabwe. Field Crop Research. 2004; 89:49-57.
21. Patil SV, Bhosale AS, Khambal PD. Effect of various levels of fertilizers on growth and yield of finger millet. Journal of Agriculture and Veterinary Science. 2015; 8(6):49-52.
22. Raj NS, Shetty NP, Shetty HS. Seed biopriming with Pseudomonas fluorescens isolates enhances growth of pearl millet plants and induces resistance against downy mildew. International Journal of Pest Management. 2004; 50(1):41-48.
23. Ramamoorthy K, Natarajan N, Lakshmanan A. Seed biofortification with *Azospirillum* spp. for improvement of seedling vigour and productivity in rice (*Oryza sativa* L.). Seed Science and Technology. 2000; 28(3):809-815.
24. Srivastava AK, Bose B. Effect of nitrate seed priming on phenology, growth rate and yield attributes in rice (*Oryza sativa* L.). Journal of Agriculture and Veterinary Science. 2012; 25:174-81.
25. Subedi DK, Ma BL. Seed priming does not improve corn yield in a humid temperate environment. Indian Journal of Agronomy. 2005; 97:211-218.
26. Tanwar SP, Rokadia P, Singh AK. Effect of row ratio and fertility levels on the performance of chickpea (*Cicer arietinum*) and linseed (*Linum usitatissimum*) intercropping system under rainfed conditions. Indian Journal of Agronomy. 2011; 56(3):87-92.
27. Turgut I, Duman A, Wietgrefe GW, Acikgoz E. Effect of seeding rate and nitrogen fertilization on proso millet under dryland and irrigated conditions, Journal of Plant Nutrition. 2006; 29:2119-2129.
28. Vipul Singh, Ghanshyam Singh, Vinay Kumar, Manoj Kumar, Ajay Singh. Performance of chickpea-mustard intercropping on yield and economics of chickpea and mustard crop under different fertility management and various row combinations. International Journal Current Microbiology Applied Science. 2019; 8(1):236-249.
29. Zende NBSA, Chavan SB, Bhagat SS, Pinjari, Mahale MM. Effect of integrated nutrient management on growth, yield, quality and economics of sweet corn under lateric soil condition of Konkan region. Crop Protection and Production. 2006; 3(1):33-36.