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ON-FARM ADAPTATION OF SOME OILSEED CROPS UNDER ACIDIC SOIL OF SYLHET REGION IN BANGLADESH

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Abstract

Screening of improve varieties for new areas is necessary to address the soil and environment for improving crop production systems. In this context, six separate field trials were conducted at farmer's field in Sylhet areas for the two consecutive crop seasons during 2017-18 and 2018-19, respectively to evaluate the performance of improved varieties of crops with the existing cultivars. Each experiment was laid out in randomized complete block design with six dispersed replications. The unit plot size was varied with experiments. The result showed that improved varieties of oilseed crops mustard var. BARI Sarisha-16, soybean var. BARI Soybean-6, groundnut var. BARI Chinabadam-9, sesame var. BARI Til-4 and sunflower var. BARI Surjomukhi-2 performed better under the soil and climatic conditions of Sylhet region. This result reveled that these varieties of oilseed crops could be suitable for higher productivity and economic return.

Introduction

Bangladesh is one of the most important agrarian's countries in the world; agriculture sector is the country's main source of food security, employment, and poverty alleviation. More than 70 percent of Bangladesh's population and 77 percent of its workforce lives in rural areas. Nearly half of all of Bangladesh's workers and two-thirds in rural areas are directly employed by agriculture, and about 87 percent of rural households rely on agriculture for at least part of their income (World Bank Group, 2019; Rahman and Schmitz, 2007). The Sylhet regions are mostly under the Agroecological zone -20 (Eastern Surma Kushiyara Floodplain), and the soils of this region are strongly acidic (pH 4.5-5.5). Farmers mainly grow rice under rain fed ecosystem. The climate of this region is suitable for potato, tomato, cabbage, aroids, wheat and different pulse and oilseed crops (Nazrul, 2017; Nazrul and Shaheb, 2014; Nazrul *et al.,* 2013; Shaheb *et al*., 2012; Sarker, *et al.,* 2012; Nazrul and Shaheb, 2012; Rahman *et al.,* 2013) in *Rabi* and *Kharif* seasons, respectively.

Generally, farmers in this region cultivate different crops of local varieties in both seasons under poor management practices. As a result, much lower yield is achieved in Sylhet areas (Nazrul *et al.,* 2017; Nazrul *et al.,* 2013). So, introduction of new crops with modern varieties along with appropriate agronomic management practices would boost up the farm productivity that will reduce the poverty level of resource poor farmers of that area. In addition, agriculture is the only economic activity of most small farmers in this region. About 40-45 % lands of total cultivable area remain fallow due to lack of irrigation and not available suitable different crop varieties under present prevailing agro-climatic situation. Nazrul *et al.* (2020) reported that some crop varieties of pulse, tuber and spices performed better under the soil and climatic conditions of Sylhet region. Information related to varietal adaptability of different oilseed crops like mustard, soybean, groundnut, sesame, linseed and sunflower in the study areas of rice based rainfed eco-system under climate change situation is scanty. Hence, an

experiment was undertaken with an objective to evaluate the yield performance of improved varieties of oil seeds crops with the existing cultivars at farmers' field of Sylhet region.

Materials and Methods

A total of six separate trials were conducted at farmer's field in Sylhet area for two consecutive crop seasons during 2017-18 and 2018-19 to evaluate the performance of improved crop varieties with the existing cultivars cultivated by the farmers. The study areas are located at Latitude 24° 29' N and Longitude 91° 39' E of Bangladesh. The soil of experimental plots was non-calcareous gray with low organic matter content (1.23%), low soil pH (4.5-5.4), very low total N (0.06%), low content of P (9.46 µg/g), K (0.14) and S (10.07) whereas Zn (1.13) and Boron (0.51) medium and optimum, respectively. Each experiment was laid out in randomized complete block design with six dispersed replications. The unit plot size was varied with the experiments.

The monthly air temperature and rainfall during the study period are presented in Figure 1. The monthly mean minimum and maximum temperature was 9.53^{0}C and 36.43^{0}C during the crop season, respectively. During experimentations a total of 7684 mm precipitation was occurred in this region; whereas lowest rainfall 10.9 mm and highest 2465 mm was occurred in January and June, respectively.

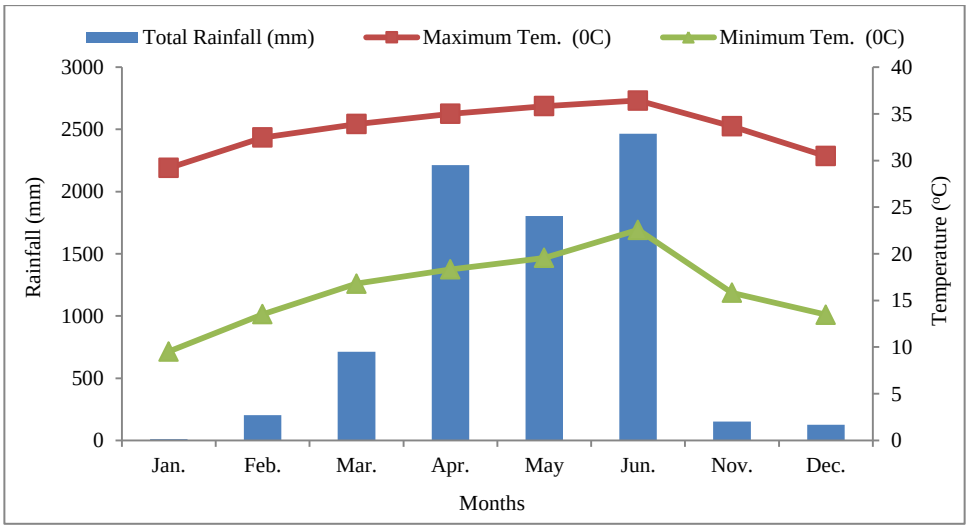

Fig. 1. Average of two years monthly maximum and minimum air temperatures (^{0}C) and total rainfall (mm) during study period *(*Source: Meteorological Department, Sylhet*)*

Mustard

The on-farm trial was conducted at farming system research and development (FSRD) site, Kamalbazar, South Surma, Sylhet. Six mustard varieties viz. BARI Sarisha-9, BARI Sarisha-11, BARI Sarisha-13, BARI Sarisha-14, BARI Sarisha-15 and BARI Sarisha-16 were used in this field trial. The crop was fertilized with 90-27-32-10-1.0-0.5 kgha^{-1} of NPKSZnB (FRG, 2012). Half of nitrogen and all amounts of phosphorous, potassium, sulpher, zinc and boron were applied during final land preparation. The remaining half nitrogen was applied as top dress at the time of flower initiation. The experiment was conducted under rainfed condition. The seeds were sown on 20-25 November in broadcast method in both years maintaining the seed rate of 7-8 kg ha^{-1}. The unit plot size was 12 m×20 m. The crop was harvested on18-25 February in both years. Pesticides Rovral 50 WP 0.2 % for controlling gray blight and Nitro 505 EC @ 0.5 ml L^{-1}of water was used against mustard aphid.

Soybean

The experimentation was conducted at farmer's field under farming system research and development (FSRD) site, Kamalbazar, South Surma, Sylhet. Three soybean varieties viz. BARI Soybean-5, BARI Soybean-6 and Shohag were used in this experiment. Cop was fertilized with 23-30-50-15-1.0 kg ha^{-1} of NPKSB (FRG, 2012). All fertilizer nutrients were applied during final land preparation. Seeds of soybean were sown on 15-18 December in broadcast method in both years with maintained the seed rate of 80-90 Kg ha^{-1}. The unit plot size was 8 m×5 m. The crop was harvested at full maturity on 5-10 April in both years. There was no remarkable disease and pest attack, except white fly and it was successfully controlled by applying Nitro 505 EC at the rate of 0.5 ml L^{-1}.

Groundnut

The experiment was conducted at farmer's field under multilocation testing (MLT) site, Sunamganj. The experimental material comprised of two varieties viz. BARI Chinabadam-8 and BARI Chinabadam-9 including local were used in this experiment. The seeds of groundnut were sown on 2-5 November in both years with maintaining the spacing of 40 cm×15 cm. The unit plot size was 8 m×5 m; where total of 650 plants were accommodated and harvested on 5-7 March in both years with maintaining 90-100 kg seeds ha^{-1}. Before sowing, seeds were treated with Provex @ 0.2% to prevent seed and soil borne diseases. Weeding followed by irrigations were done twice at 15-20 and 45-50 days after sowing of seed and earthing up was followed as per package of practices of groundnut (Pradheeban *et al.,* 2016).The crop was fertilized with 25-160-85-300-10 kg urea-TSP-MoP-Gypsum-Boric acid ha^{-1}. The half urea and entire amount of TSP, MP, gypsum and boric acid were applied during final land preparation. The rest half urea was top dressed at the initial stage of peg developments.

Sesame

The on-farm trial was conducted at upper-part of Hakaluki haor, Beanibazar area under Sylhet. Four sesame varieties viz. BARI Til-2, BARI Til-3, BARI Til-4 and T-6 was used in this trial. The unit plot size was 10 m x 10 m. Seeds were sown in broadcast method. The fertilizer nutrients NPKSZnB @ 60-30-40-18-2-0.5 were applied in the form of urea, TSP, MoP, Sulpher, Gypsum and Boron, respectively as per FRG 2012. Full dose of all fertilizers and half of urea were applied at the time of final land preparation. Remaining nitrogen was applied as top dress at 25-30 days after sowing. The trial was conducted under rainfed condition. Sesame seeds (7-8 kg ha^{-1}) were sown on 15-18 March in both years. The crop was harvested at full maturity on 12-15 June in both years. Intercultural operations viz. weeding and thinning were done in order to support normal plant growth.

Linseed

The experiment was conducted at farmer's field under multilocation testing (MLT) site, Zokiganj. Four different cultivars of linseed viz. BARI Tisi-1 (Nila), Noakhali local, Patuakhali local and Zokiganj local were tested in this field trial. The crop was fertilized with 31-13-20-8 kg ha^{-1} of NPKS (FRG, 2012). Half of nitrogen and all phosphorous, potassium and sulpher were applied during final land preparation. The remaining nitrogen was applied at the time of flower initiation as top dress. The seeds (7-8 kg ha^{-1}) were sown on 20-25 November in both years in broadcast method. The unit plot size was 10 m×8 m. Once weeding followed by irrigation was provided at 30-35 days after sowing. The crop was harvested at maturity on 13-15 March in both years. The fungicide Bavistin 70 WP (0.2 %) was applied for controlling foot rot disease and in order to support normal growth of linseed.

Sunflower

The field trial was conducted at farming system research and development (FSRD) site, Kamalbazar, South Surma, Sylhet. Three sunflower varieties viz. BARI Surjomukhi-2, BARI Surjomukhi-3 and Hysun-33 were used in this experiment. The crop was fertilized with 90-35-75-25-1.0-0.5 kg ha^{-1} of NPKSZnB (FRG, 2012). Half of nitrogen and all phosphorous, potassium, sulpher, zinc and boron were applied during final land preparation. The remaining nitrogen was applied as top dress in two equal splits at 20-25 and 40-45 days after sowing (DAS). The seeds (10-12 kg ha^{-1}) were sown on 15-20 November in both years maintaining the spacing of 50 cm×30 cm. The unit plot size was 8 m×5 m. The crop was harvested on 25-28 February in both years. Seeds were treated with Provex-200 @ 3g kg^{-1} before sowing. Twice irrigations were done at 30 and 50 days after sowing of seed. The yield data was recorded from whole plot basis. Yield and yield contributing characters were analyzed statistically using "STAR" software package and means were separated by LSD test at 0.05 % level of significance.

Results and discussion

Mustard

Seed yield and yield components of mustard varieties are presented in Table 1. Number of days required from sowing to harvesting (76-103 days) of mustard varieties differed significantly. The duration of BARI Sarisha-16 was the maximum (103 days) which was at par with BARI Sarisha-13 (100 days) and BARI Sarisha-11 (98 days). On the contrary, duration of BARI Sarisha-14 (84 days) and BARI Sarisha-15 (88 days) was identical but 19 days shorter than BARI Sarisha-16.The maximum plant height (126.30 cm) was recorded in BARI Sarisha-16 which was closely followed by BARI Sarisha-11 and lowest plant height (80.00 cm) was measured in BARI Sarisha-9.On the other hand, number of siliquaplant^{-1} was significantly different among the varieties (Table 1). The highest number of siliquae plant^{-1} was recorded in BARI Sarisha-11 (164) which was identical with BARI Sarisha-16 (154). Inversely, BARI Sarisha-13 (68) and BARI Sarisha-15 (66) produced statistically similar number of siliquaplant^{-1} but much lower than BARI Sarisha-16 (154). The lowest number of siliqua plant^{-1} was observed in BARI Sarisha-9 (53). The results were in agreement with the findings of Islam *et al*. (2015).

Number of seeds siliqua^{-1} is a genetically controlled trait differed significantly in mustard varieties. BARI Sarisha-14 had the highest number of seeds siliqua^{-1} (26.67). BARI Sarisha-11 (11.38) and BARI Sarisha-16 (12.67) produced statistically identical number of seeds siliqua^{-1}. The seed size i.e. 1000-seed weight of BARI Sarisha-11 (3.1 g), BARI Sarisha-13 (3.4 g) and BARI Sarisha-14 (3.7 g) was identical. BARI Sarisha-16 produced the smaller sized seeds (2.4g) which was statistically similar with BARI Sarisha-9 (2.5 g). Yield is directly proportional to the cumulative effect of yield attributes. The highest seed yield was recorded in BARI Sarisha-16 (1230kgha^{-1}) which was at par with BARI Sarisha-11 (1140kgha^{-1}). The higher seed yields in the afore said varieties were occurred due to higher number of siliqua plant^{-1} though much lower in seedssiliqua^{-1} and also seed size. Mian and Islam (2010) also reported higher seed yield due to higher siliqua plant^{-1}. On the contrary, as a short duration varieties, BARI Sarisha-14 and BARI Sarisha-15 produced significantly lower seed yields of 890 and 980 kg ha^{-1}, respectively compared to long duration varieties (100-103days). The results revealed that long duration var. BARI Sarisha-11 and BARI Sarisha-16 could be grown in fallow land areas for higher yield but if other crops grown in *Kharif*-I then short duration mustard variety BARI Sarisha-14 and BARI Sarisha-15 could be grown.

Table 1. Days to maturity, plant height, seed yield and yield contributing characters of mustard varieties at rainfed eco-system (Pooled)

Name of variety	Days to maturity	Plant height (cm)	Siliqua plant^{-1}	Seeds Siliqua^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1})
BARI Sarisha-9	76	80.00	53	13.33	2.5	680
BARI Sarisha-11	98	105.00	160	11.38	3.1	1140
BARI Sarisha-13	100	100.70	68	22.33	3.4	970
BARI Sarisha-14	84	85.00	55	26.67	3.7	780
BARI Sarisha-15	88	87.00	66	22.67	3.2	780
BARI Sarisha-16	103	126.30	154	12.67	2.4	1230
$LSD_{(0.05)}$	5.54	14.69	5.3	5.29	0.2	0.18
CV (%)	3.30	8.44	7.5	16.10	5.1	10.95

Soybean

Plant height, number of pods plant^{-1}, seeds pod^{-1}, 100-seed weight and seed yield of soybean varieties are presented in Table 2. The tallest plant (54.80 cm) was obtained by BARI Soybean-6. Pods plant^{-1} and seeds pod^{-1} of different soybean varieties did not differ significantly due to uniformity of pods plant^{-1} and seeds pod^{-1}. BARI Soybean-6 produced numerically maximum number of pods, as a result, the highest number of pods plant (31.10) was recorded in this variety and it was statistically identical with others. Higher number of seeds pod^{-1} was also observed in BARI Soybean-6. The weight of 100-seed of soybean varieties varied significantly in rain fed eco-system under climate change situation. Hundred seeds weight followed a similar trend to seeds pod^{-1}. The highest weight (12.41 g) of 100-seed was recorded in BARI Soybean-6. Seed yield was not varied significantly but numerically BARI Soybean-6 produced higher seed yield (1365 kg ha^{-1}) while Sohag was the lowest yielder (1184 kg ha^{-1}). Yield variation in different soybean varieties was attributed to the cumulative effects of different yield components. Similar finding was also reported by Islam *et al*. (2015) and Islam and Biswas (2010).

Table 2. Yield contributing characters and yield of soybean varieties at farmer's field of Sylhet (Pooled)

Variety	Plant height (cm)	Pods plant^{-1}	Seeds pod^{-1}	100-seed weight (g)	Days to maturity	Seed yield (kg ha^{-1})
BARI Soybean-5	51.90	30.76	2.45	10.83	112	1285
BARI Soybean-6	54.80	31.10	2.60	12.41	113	1365
Sohag	50.58	29.70	2.30	10.10	112	1184
$LSD_{(0.05\%)}$	2.36	NS	NS	1.96	NS	NS
CV (%)	2.60	7.48	6.80	10.07	6.24	7.93

Groundnut

The maximum days to maturity was recorded in BARI Chinabadam-9 followed by BARI Chinabadam-8 (Table 3). The maximum number of pods plant^{-1} (16.87) was recorded in BARI Chinabadam-9 followed by BARI Chinabadam-8, while the lowest in local cultivar (14.83). The highest 100-kernel weight (39.65 g) was recorded in BARI Chinabadam-9 and the lowest (33.92 g) was in local. Higher kernel yield contributed to greater shelling percent and provide higher nut yield. The maximum shelling percent (76.64%) of groundnut was recorded in BARI Chinabadam-9 followed by BARI Chnabadam-8 and local. The yield did not varied significantly but numerically higher nut yield (1.57 t ha^{-1}) was recorded in BARI Chinabadam-9 followed by BARI Chinabadam-8 (1.40 t ha^{-1}) and the lowest in local (1.25 t ha^{-1}). Among the yield components, number of pods plant^{-1} and kernel weight were more closely associated with pod yield ha^{-1}.

Table 3. Days to maturity, yield contributing characters and nut yield of different groundnut varieties at farmer'sfield in Sylhet region (Pooled).

Variety	Days to maturity	Pods plant^{-1} (no.)	100-kemel wt. (g)	Shelling (%)	Nut yield (t ha^{-1})
BARI Chinbadam-8	139	15.67	34.81	73.14	1.40
BARI Chinbadam-9	142	16.87	39.65	76.64	1.57
Local	137	14.83	33.92	69.78	1.25
LSD(0.05)	NS	NS	NS	NS	NS
CV (%)	1.37	9.55	7.60	3.43	13.28

Sesame

Results indicated that the maximum plant height (101.10 cm) was found in the variety BARI Til-4 that was followed by T-6 and BARI Til-2 (99.89 cm). The maximum number of pods plant^{-1} was recorded in var. BARI Til-2 (71.33) that was followed by T-6 and BARI Til-4. Higher number of seeds pod^{-1} was found in var.T-6 (70.33) followed by BARI Til-2 (67.33) and the lowest seeds pod^{-1}in BARI Til-3 (53.00). The maximum pod length (2.90 cm) was found in T-6 followed by BARI Til-2. The maximum seed yield was recorded in BARI Til-4 (1.15 t ha^{-1}) that was statistically similar to that of BARI Til-2 (1.14 t ha^{-1}), whereas lowest seed yield was produced by the variety BARI Til-3 (0.84 t ha^{-1}).

Table 4. Seed yield and yield contributing characters of sesame varieties at farmer's field of Sylhet (Pooled)

Variety	Plant height (cm)	Plant m^{-2} (nos.)	Pods plant^{-1} (nos.)	Seeds pod^{-1} (nos.)	Pod length (cm)	Seed yield (t ha^{-1})
BARI Til-2	99.89	37.23	71.33	67.33	2.67	1.14
BARI Til-3	95.76	44.57	50.33	53.00	2.37	0.84
BARI Til-4	101.10	40.57	65.33	61.33	2.60	1.15
T-6 (Control)	99.83	41.23	68.67	70.33	2.90	0.98
LSD(0.05)	2.57	NS	10.21	11.69	0.19	0.18
CV (%)	1.25	9.61	8.33	8.92	1.84	8.14

Linseed

The highest plant height was obtained in BARI Tisi-1 (64.85 cm) while the shortest plant in Noakhali-local (52.73 cm). The highest number of pods plant^{-1} was recorded in Zakigonj-local (31.40). But plants m^{-2} and seeds pod^{-1} was non-significant (Table 5). Among the varieties, Zakigonj-local produced highest 1000 seeds weight (4.01 g) that was followed by Noakhali local (3.66 g) and the lowest 1000 seeds weight in BARI Tisi-1 (3.57 g). Likewise, the highest seed yield (0.94 t ha^{-1}) of linseed was recorded in Zakigonj-local that was statistically followed by Noakhali-local (0.81 t ha^{-1}). However, the lowest seed yield (0.74 t ha^{-1}) was found in Patuakhali-local.

Table 5. Seed yield and yield contributing characters of linseed at farmer's field of Sylhet region (Pooled)

Variety	Plant height (cm)	Pods plant^{-1} (nos.)	Plants m^{-2} (cm)	Seeds pod^{-1} (nos.)	1000- seed weight (g)	Seed yield (t ha^{-1})
Nila (BARI Tisi-1)	64.85	21.28	221	7.22	3.57	0.76
Noakhali-local	49.55	20.63	191	7.37	3.66	0.81
Patuakhali-local	52.73	19.13	207	7.53	3.64	0.74
Zakigonj-local	50.80	31.40	201	7.73	4.01	0.94
LSD (0.05)	4.17	9.6	NS	NS	0.6	0.27
CV (%)	3.69	20.55	8.21	7.53	4.74	5.93

Sunflower

The var. BARI Surjomukhi-2 produced the maximum (167.77 cm) plant height, which was lowest value (91.02 cm) produced by BARI Surjomukhi-3 at physiological maturity (Table 6). The plant heights of sunflower var. BARI Surjomukhi-2 was uneven but means height was statistically than others. The differences in plant height may be attributed to the genetic potential of variety and the other prevailing environmental conditions. The plant height of some sunflower hybrids increased with increasing temperature. Similar results were reported by Anderson *et al.* (1978); Qadir (2006) and Canava *et al.* (2010).The maximum days to maturity (126) were recorded in hybrid Hysun-33 and minimum days to maturity were observed in BARI Surjomukhi-3 (102).

Total seeds head^{-1} (903.15) was highest in BARI Surjomukhi-2 and that of minimum (757.48) was produced in BARI Sunflower-2. This may be due to comparatively large head size and small seed size. Similar trend was also found in case of seed weight head^{-1}. Maximum seed weight (51.42 g) head^{-1} as obtained from BARI Surjomukhi-2 followed by hybrid Hysun-33 and BARI Surjomukhi-3. The 1000-seed of the sunflower cultivars ranged from 61.38 to 95.00 g. The sunflower var. BARI Surjomukhi-2 produced the maximum 1000-seed weight (95.00 g), which was significantly different from the other values of this trait. BARI Surjomukhi-3 produced the minimum 1000-seed weight (61.38 g) in Table 4. Similar 1000-seed weight was reported by Hossain *et al.* (2018). The seed yield of tested sunflower varieties did not differ significantly. The seed yield plant^{-1} of all the sunflower cultivars ranged from 1783 to 2033 kg ha^{-1}. Though seed yield was not significant but maximum seed yield (2033 kg ha^{-1}) was observed in BARI Surjomukhi-2.The lowest seed yield (1783 kg ha^{-1}) was found in the BARI Surjomukhi-3.

Table 6. Seed yield and yield contributing characters of sunflower varieties at farmer's field of Sylhet region (Pooled)

Variety	Plant height (cm)	Days to maturity	Total seed head^{-1}	Seed weight head^{-1} (g)	1000- seed weight (g)	Seed yield (kg ha^{-1})
BARI Surjomukhi-2	167.77	105	903.15	51.42	61.38	2033
BARI Surjomukhi-3	91.02	102	757.48	42.79	65.00	1783
Hysun-33	138.00	126	793.87	43.14	95.00	1800
$LSD_{(0.05\%)}$	6.65	2.77	2.78	2.77	2.78	NS
CV (%)	3.25	5.37	2.57	2.60	5.53	11.37

Conclusion

It showed from the results that mustard var. BARI Sarisha-16, soybean var. BARI Soybean-6; groundnut var. BARI Chinabadam-9; sesame var. BARI Til-4 and sunflower var. BARI Surjomukhi-3 could be grown in Sylhet region under AEZ 20 for higher productivity and economic return.

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