



ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural UniversityJournal home page: <http://baures.bau.edu.bd/jbau>, www.banglajol.info/index.php/JBAU

Yield and economics of potato in short duration rice-based cropping system in Rangpur district

✉Mrinmoy Guha Neogi¹, Abul Khair², A.K.M. Salah Uddin³ and M. Mamunur Rashid⁴¹University of Western Australia (UWA), Crawley WA 6009, Australia, ²Department of Botany, Jahangirnagar University, Savar, Dhaka, ³FAO, Dhanmondi R/A, Dhaka and ⁴RDRS Bangladesh, Jail Road, Rangpur, Bangladesh

ARTICLE INFO

**Abstract***Article history:*

Received : 06 February 2019

Accepted : 18 May 2019

Published: 30 June 2019

Keywords:

Early planting, late planting and net benefit for early planting of potato

Correspondence:

Mrinmoy Guha Neogi

✉: mgneogi@gmail.com

The potato crop is sensitive to environmental factors as optimum planting time of potato depends on the most favorable temperatures extending over the longest period of the crop season and requires less than maximum and above the minimum temperatures for emergence after planting. To secure good yield, the potato crop should be planted in such a time that all the three growth and development phases pass through favorable environmental conditions. Cognizant the above facts, a field experiment was conducted at RDRS Farm, Rangpur during 2014 and 2015 for cultivating potato in different dates with two popular potato varieties like Diamont and Cardinal to find out the optimum planting time of potato production in Bangladesh under short duration rice-based cropping system as well as assess the economic viability of potato cultivation in November. The cost-benefit analysis indicates that no major variation was observed in the performance of two varieties e.g. Diamont and Cardinal. But significant variation was observed in different planting dates. The 22nd November planting of both Diamont and Cardinal produced highest yield (29.2 and 28.8 t/ha, respectively) compared to other three planting dates like 7th November (27.8 t/ha and 26.9 t/ha), 7th December (21.1 t/ha and 19.8 t/ha) and 22nd December (15.2 t/ha and 14.7 t/ha). The 7th November planting was found economically profitable for both the varieties, where the highest economic return was recorded as TK. 2,06,372/ha for Diamont and TK. 2,08,772/ha for Cardinal. Thus, from the economic point of view, the 7th November planting performed best for both varieties. The cost of production was gradually higher in case of late planting due to use of higher amount of pesticides in the crop field. It may be concluded that potato could be cultivated during 1st half of November month, just after harvesting of short duration *aman* rice in October that will bring harvesting of potato in 1st half of February which can ensure highest net income from potato cultivation and enables farmers to cultivate next crop like mungbean as additional income.

Copyright:

©2019 by authors and BAURES. This work is licensed under the Creative Commons Attribution International License (CC By 4.0).

Introduction

The potato is the fourth leading food crop in the world after rice, wheat and maize because of its great yield potential and high nutritive value. Potato is a rich source of starch and it is consumed for its calorie value. In terms of energy produced per unit area of land, potato exceeds all the cereals. Protein yield per unit area is also superior to the cereal grains and second only to soybean. Bangladesh is the seventh largest potato production countries in the world (AMIS, 2016). After rice, potato is the third most important crop in Bangladesh (Siddique *et al.* 2015). The area under this crop is increasing rapidly and the farmers are gradually adopting it as a cash crop. Due to cold storage facilities, potato is available in the market throughout the year while almost every family of the country consumes potato round the year. Potato is now the second staple food item in Bangladesh and per person potato consumption rose to ten times more than that were in 1980 (The Prothom Alo, 2015).

Rice is becoming more expensive and scarce while potato has higher food nutrients (no fat, higher vitamin

C and quality protein compared to rice). Therefore potato can play an important role to ensure food security with enhancing nutrition value through more potato consumption. The average yield of potato is 13.32 t/ha which is very low compared to other potato producing countries like 43.2 t/ha in France, 44.7 t/ha in Netherlands and 44.6 t/ha in the USA in 2007. The production of potato was 2.93 million metric tons from 0.243 million hectares of land in Bangladesh during 1999-2000 (BBS, 2000). In 2007-2008, the production of potato was nearly 8 million metric tons from 0.5 million hectares (Bangladesh Potato Campaign, 2008) while in 2015-2016, it was 9.47 million metric tons from 0.475 million hectares (BBS, 2016).

To increase production of food crops in Bangladesh, both vertical and horizontal expansions are needed. The possibilities of horizontal expansion for major food crops are very limited due to the scarcity of land. Vertical expansion by introducing new and appropriate production technologies e.g. suitable/alternate cropping pattern which helps increase cropping intensity is feasible and economical to enhance the yield and income

Cite this article

Neogi, M.G., Khair, A., Salah Uddin, A.K.M. and Rashid, M.M. 2019. Yield and economics of potato in short duration rice-based cropping system in Rangpur district. *Journal of Bangladesh Agricultural University*, 17(1): 172–178. <https://doi.org/10.3329/jbau.v17i2.41940>

reducing per unit production cost. The major constraints for potato production in Bangladesh are (i) lack of quality seeds (ii) farmers have less scope to maintain the appropriate planting time due to long duration *aman* rice cultivation and (iii) incidence of diseases and pests due to late planting (Haque, 2010; Islam et al. 2014; and Siddique et al. 2015).

The amount of tuber infection which goes to stores through seed tubers ranges 0.01-3%, is more than enough to initiate late blight epidemic in the next crop season (Rahman et al. 2007). To secure good yields, the potato crop should be planted in such a time that all the three growth and developmental phases pass through favorable environmental conditions. The optimum planting time depends on (i) the most favorable temperatures extending over the longest period of the crop season, associated with less than maximum and above the minimum temperatures necessary for emergence after planting, (ii) the duration of cultivars, its reaction to high or low temperature, and susceptibility to late blight, (iii) soil moisture status under rainfed conditions and (iv) effective growing season depending on whether the crop is allowed to grow to maturity or lifted prior to maturity.

The optimum growth and development of potato require a temperature range of 15°C-21°C (Siddique et al. 2015). It is very important to know the growth and development of potato tubers in relation to time of planting under the short day and short growing season of the tropical areas like Bangladesh. Islam et al. (2014) observed that November was the best for potato planting which could avert the disease by maturing crop before the severe infestation period. They also found that due to use of long duration T. *aman* rice variety BR11 causing delay in potato planting in December, which ultimately reduced yield and favored crop failure due to late blight diseases. Scientists found that the planting between 10 to 20th November was the best for the production of seed potatoes in Bangladesh whereas for ware potatoes planting could be delayed up to 1st December. They found that seed quality deteriorated when planting was done after 20th November, but the total yields were affected when planted after 1st December.

Haque, 2010 pointed that most of the farmers of northern region of Bangladesh used to cultivate potato in the month of December, after harvest of their transplanted *aman* rice (November to mid-December) and received low yield compared to November planting. As recently developed short duration rice variety is the possible way to harvest rice in the month of October, of which farmers are now able to cultivate potato in right time (in November) to ensure good yield and income. Side by side, day laborers will get job not only from harvest of short duration rice in the lean period, but also to access job in the early November (*Kartik* month) by cultivating potato, especially from land preparation, seed sowing, then application of basal fertilizer as well as earthing-up after seed sowing. So the potato cultivation

in early November is not only increases the production but a wider opportunity for day laborers to access job in the month of *Kartik* (lean period), when the food stocks of the poor people have been heavily depleted. Islam et al. (2014) observed that short duration rice created job opportunity for the poor in *monga* period (September-October) for harvesting rice. Keeping the views in mind, the experiment was undertaken to accommodate potato in short duration rice-based cropping pattern to increase yield and economic return and also to generate work in agricultural field in the off period during September-October.

Cognizant of the above facts, a research program has been designed on planting of potato in different dates with two most popular potato varieties in northern region of Bangladesh. The major objectives of this study are:

1. To identify the most appropriate time of potato production in northern region of Bangladesh under short duration rice – potato – mungbean cropping pattern.
2. To assess the economic viability of potato cultivation in early November under short duration rice – potato – mungbean cropping pattern to mitigate seasonal crisis.

Materials and Methods

The experiment was conducted at the RDRS Farm, Rangpur Sadar upazilla. The two most popular potato varieties (Cardinal and Diamont) with four different planting dates (7th November, 22nd November, 7th December and 22nd December) were tested through on-station research to identify suitable time of planting in support of short duration rice –potato - mungbean cropping pattern. Farmer traditionally followed the planting times in December, after harvesting T. *Aman* rice of long duration varieties. November planting dates were chosen to ensure timely planting, immediately after harvest of early *aman* rice (using short duration rice varieties), so that the cropping pattern help farmers and day laborers to get production and employment during lean period due to harvest of rice and planting of potato. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The unit plot size was 4m x 4m and the treatment combinations were as follows:

Sl. No.	Treatments
T ₁	1. Diamont X 7 November planting
T ₂	2. Diamont X 22 November planting
T ₃	3. Diamont X 7 December planting
T ₄	4. Diamont X 22 December planting
T ₅	5. Cardinal X 7 November planting
T ₆	6. Cardinal X 22 November planting
T ₇	7. Cardinal X 7 December planting
T ₈	8. Cardinal X 22 December planting

The P^H value of the soil was within the range of 5 to 5.5. The experimental plot was well ploughed.

Recommended doses of fertilizers and manure suggested by Tuber Crops Research Center (TCRC), BARI, Gazipur were used. Cow dung was incorporated in the soil during land preparation at the rate of 10 t/ha. Urea, Triple Super Phosphate (TSP), muriate of potash (MoP), gypsum, zinc sulphate and boric acid were used respectively at the rate of 325, 220, 250, 120, 14 and 6 kg per hectare. Urea, TSP, MoP, gypsum, zinc sulphate and boric acid were the sources of N, P, K, Ca, Zn and B, respectively. Seed tubers were collected from Breeders Seed Production Center, BARI, Debiganj, Panchagarh. Row to row spacing (within plot) and tuber to tuber (within row) was 60 cm and 25 cm respectively. Each plot had 7 rows and in each row 13 seed tubers were sown. Two times weeding was done at an interval of 30 days. Earthing-up was executed two times throughout the entire growing period, one at 30 days and another one at 60 days after planting. Irrigation was scheduled two times just after earthing-up. The whole crops were harvested after 90 days of planting while one row was harvested after 60 days of planting.

Statistical Analysis

The data obtained on the plant growth parameters and yield were processed by analysis of variance (ANOVA) using MSTAT-C program. The significance of the differences among the treatment means were evaluated by least significant difference (LSD) test ($P=0.05$).

Results and Discussion

Table 1. Effect of variety on the yield and yield components of potato

Treatments/ variety	% of emergence (t 15 days of planting)	Plant height(cm) at 60 DAS	Potato plant (no.)		Potato yield/plant (g)		Grading at 60 DAS (No.)			Tuber weight (kg)		Yield (t/ha)	
			60 days	90 days	60 DAS	90 DAS	(<25mm)	(25-45 mm)	(>45 mm)	60 days (1 line)	90 DAS(7 lines)	60 DAS	90 DAS
			Diamont	55.6a	58.4b	10.0a	10.7a	287.6a	458.6a	3.5a	6.3a	0.2b	3.7a
Cardinal	58.0a	63.5a	9.2b	10.0a	305.1a	451.7a	2.9a	5.9a	0.5a	3.6a	36.5a	15.7a	22.5b
LSD	5.91	4.35	0.86	1.59	17.54	39.77	0.74	0.95	0.28	0.22	1.00	0.93	0.59
CV %	14.17	7.13	12.30	21.00	5.91	11.88	31.98	21.30	109.2	8.27	3.68	8.00	3.51

Effect of planting time on the yield and yield components

The effect of planting time on the yield and yield components are presented in Table 2. There was no significant effect of planting time on percentage of emergence after 15 days of planting. Also no significant effect was found on number of plants per sub-plot after 45 days and 60 days of planting. The result revealed that plant height (69.4 cm) after 60 days of planting, potato yield per plant (380.5 gm) after 60 days of planting, and yield per hectare (29 t/ha) after harvesting of 90 days planting were significantly higher in 22nd November planting as compared with 7th November, 7th December and 22nd December planting time. The above research findings strongly support the other research results while the temperature had a great influence on the production, as temperature of 22nd November is some favorable for

Effect of variety on the yield and yield components

The effect of two varieties (Diamont and Cardinal) on the yield, yield components and crop duration was varied significantly (Table 1). Diamont variety produced the higher yield (23.3 t/ha) compared to Cardinal variety after 90 days planting (22.5 t/ha) and higher number of potato per plant (10 and 10.7) at both 60 and 90 days of planting. Size of tubers (grade less than 25 mm. and 25-45 mm.) of Diamont variety after 60 days of planting was also higher (3.4 and 6.3 respectively). The Diamont variety also produced higher yield after 60 days of planting (16 t/ha). The probable reasons might be due to plantation of larger sized tubers per hill and higher plant heights of Diamont variety (Azad *et al.* 2017) while similar literatures have been published by the Bangladesh Agricultural Research Institute (BARI) through its Krishi Projukti Handbook. On the other hand, percentage of emergence was higher in case of Cardinal variety after 15 days of planting (58%), and the plant height was also higher (63.5 cm) as compared with Diamont variety (58.4 cm). Potato yield per plant after 60 days of planting was higher in case of Cardinal variety (305.1 g) that might be the characteristics of the variety.

potato production than 7th November. Islam *et al.* 2014 pointed that November is the best for potato planting which can avert the disease by maturing crop before the severe infestation period. In case of potato yield per plant after 90 days of planting, potato grading of 25-45 mm size after 60 days of planting, tuber weight after 60 days and 90 days of planting and yield after 60 days of planting has no significant differences observed between 7th November and 22nd November planting. The highest yield was contributed by large number of leaves and stems which helped in deposition of greatest photosynthesis and ultimately maximized the yield (Alam *et al.*, 2003).

Table 2. Effect of planting time on the yield and yield component of potato

Treatments/variety	% of emergence after 15 days of planting	No. Plants /sub plot		Plant height (cm) at 60DAS	Potato yield/plant (g)			Grading 60 DAS (No)	Tuber weight (kg)			Yield (t/ha)		
					60 DAS	90 DAS	(<25mm)		(25-45 mm)	(>45 mm)	60 days (1 line)	90 DAS (lines)	60 DAS	90 DAS
		45 DAS	60 DAS											
07 th November	54.5a	90.0a	90.9a	64.3 ab	348.5b	519.1a	1.8b	7.9a	0.5ab	4.7a	44.8a	20.3a	27.4b	
22 nd November	51.8a	91.3a	91.0a	69.4a	380.5a	564.0a	2.0b	8.1a	0.7a	4.5a	46.4a	20	29.0a	
07 th December	60.0a	91.0a	91.0a	59.6b	287.0c	396.0b	2.5b	6.5a	.0b	3.0b	32.7b	13.4b	20.4c	
22 nd December	60.6a	91.0a	91.0a	50.5c	169.4d	341.5b	6.4a	1.8b	0.1b	2.2c	23.9c	9.7c	15.0d	
LSD (0.05)	8.4	0.6	0.3	6.2	24.8	76.5	1.4	1.8	0.5	0.4	10	1.8	1.1	
CV (%)	14	0.5	0.3	7.1	5.9	11.9	31.9	21.3	109.2	8.3	3.7	8.0	3.5	

Interaction effect between varieties and plating time on the yield and yield components

All the plants character varied significantly due to interaction effect between planting time and variety (Table 3). Diamont variety produced significantly the higher potato yield after 60 and 90 days of harvesting under 7th November and 22nd November planting due to higher potato yield per plants (520.5 gm and 555 gm respectively) compared to other planting dates. Size of Diamont variety tubers ranging 25-45 mm was also significantly higher under 7th November and 22nd November planting. Tuber weight of the same variety was significantly higher under 7th November and 22nd November planting.

Under 22nd November planting, Cardinal variety produced the highest yield of harvesting 90 days after planting, while Cardinal variety also produced the highest yield of harvesting 60 days after planting of 7th November and 22nd November planting. Size of tubers

under 25-45 mm was also higher in case of Cardinal variety under 7th November, 22nd November and 7th December planting. Under 22nd November planting, size of tubers above 45 mm was also higher in Cardinal variety of harvesting 60 days after planting. Several studies have proved the efficiency of early plantation of potato. Rahman *et al.* (2007) reported that potato yield was obtained from 1st November planting of 16.37 t/ha and it showed statistically similar to 15th November planting of 15.99 t/ha but differed significantly with 30th November planting (13.55 t/ha). The overall result indicates that the planting of 22nd November and harvesting after 90 days of planting, both the Diamont and Cardinal varieties produced the higher yield of 29.19 t/ha and 28.83 t/ha respectively. According to Uddin *et al.* 2013, the research findings has proved that optimum planting time, i.e. November planting reduced attack of various insects and diseases and increased the yield of potato.

Table 3. Interaction effect between varieties and planting time on the yield and yield components of potato.

Treatment/ Variety	Plant height (cm) at 60 days of sowing	Potato yield/plant (g)		Grading (No.) after 60 days of sowing			Tuber weight (kg)		Yield (t/ha)	
		60 days of sowing	90 days of sowing	(<25mm)	(25-45 mm)	(>45 mm)	60 days (1 line)	90 days (7 lines)	60 days of sowing	90 days of sowing
Diamont x 07 th Nov.	60.4bcd	341.0b	520.5a	2.4b	8.3a	0.5ab	4.7a	44.8a	20.2a	27.8ab
Diamont x 22 nd Nov.	67.3abc	376.0ab	555.0a	2.1b	8.8a	0.5ab	4.6a	46.7a	20.1a	29.2a
Diamont x 07 th Dec.	58.3 cd	274.5c	402.0b	2.3b	6.9a	0.0b	3.1b	33.7b	13.5b	21.0c
Diamont x 22 nd Dec.	47.7e	158.7d	357.0b	7.0a	1.3b	0.0b	2.3c	24.2c	10.0c	15.1d
Cardinal x 07 th Nov.	68.2 ab	356.0ab	517.7a	1.2b	7.5a	0.6ab	4.7a	44.7a	20.4a	26.9b
Cardinal x 22 nd Nov.	71.6a	385.0a	573.0a	1.9b	7.5a	0.9a	4.5a	46.1a	19.6a	28.8a
Cardinal x 07 th Dec.	60.9 bcd	299.5c	390.0b	2.6b	6.2a	0.0b	3.0b	31.6b	13.2b	19.8c
Cardinal x 22 nd Dec.	53.3de	180.0d	326.0b	5.7a	2.3b	0.3ab	2.1c	23.5c	9.3c	14.7d
LSD (0.05)	8.7	35.1	108.3	2.0	2.6	0.8	0.6	2.7	2.5	1.6
CV (%)	7.13	5.91	11.88	31.98	21.3	109.2	8.27	3.68	8	3.51

The Cost-Benefit analysis of yield and income of potato (Diamont variety) as affected by different planting dates

The economic analysis of different planting dates of potato (Diamont variety) is presented in Table 4. The yield of 22nd November planting was significantly higher compared to that of other planting dates like 7th November, 7th December and 22nd December. The production cost per hectare for 7th November, 22nd November, 7th December and 22nd December was calculated as Tk.1,36,065, Tk. 1,52,122, Tk. 1,58,287 and Tk.1,58,581 with yield of 27.8 t/ha, 29.2 t/ha, 21.1 t/ha and 15.2 t/ha respectively. The net income was

calculated as Tk. 1,97,535/ha, Tk. 1,83,678/ha, Tk. 73,813/ha and Tk. 8,619/ha from 7th November, 22nd November, 7th December and 22nd December planting respectively. It shows (Table 4) that the marginal rate of return (MRR) was the highest with 7th November planting. Gross return of potato planting in 7th November was higher compared to other planting dates, mostly because of less production cost due to use of less pesticides because of favorable weather and higher market price of early potato harvests. Thus, from the economic point of view, 7th November planting could be recommended.

Table 4. Performance of yield and income of potato (Diamont variety) as affected by different planting dates

Treatment	Yield (t/ha)	Price (Tk/kg)	Production cost per hectare of land				Totalcost (Tk)	Gross Income (Tk)	Net profit (Tk)
			Seed cost (Tk)	Fertilizer cost (Tk)	Pesticide cost (Tk)	Land preparation, Intercultural operations and harvesting cost (Tk)			
7 th Nov. planting	27.8	12	56000	34815	3680	32733	127228	333600	206372
22 nd Nov. planting	29.2	11.5	56000	36115	12560	38610	143285	335800	192515
7 th Dec. planting	21.1	11.5	56000	37907	16530	39013	149450	242650	93200
22 nd Dec. planting	15.2	11.5	56000	36760	18590	38394	149744	174800	25056

The Cost-Benefit analysis of yield and income of potato (Cardinal variety) as affected by different planting dates

The economic analysis of different planting dates of potato (Cardinal variety) is presented in Table 5. The yield of 22nd November planting was higher compared to that of other planting dates like 7th November, 7th December and 22nd December. The production cost per hectare for 7th November, 22nd November, 7th December and 22nd December was calculated as TK 1,27,228, TK. 1,43,285, TK. 1,49,450 and TK. 1,49,744 with yield of

26.88 t/ha, 28.83 t/ha, 19.78 t/ha and 14.70 t/ha, respectively. The net income was calculated by TK. 209772 /ha, TK. 202675 /ha, TK. 87910 /ha and TK. 26656 /ha of 7th November, 22nd November, 7th December and 22nd December, respectively. It shows (Table 5) that the marginal rate of return (MRR) was the highest with 7th November planting due to less production cost because of less pesticide uses in favorable weather and higher market price for early potato harvests. Thus from the economic point of view, 7th November planting could be recommended.

Table 5. Performance of yield and income of potato (Cardinal variety) as affected by different planting dates

Treatment	Yield (t/ha)	Price (Tk./kg)	Production cost per hectare of land				Total cost (Tk)	Gross Income (Tk.)	Net profit (Tk)
			Seed cost (Tk)	Fertilizer cost (Tk)	Pesticide cost (Tk)	Land preparation, Intercultural operations & harvesting cost (Tk.)			
7 th Nov. planting	26.88	12.5	56000	34815	3680	32733	127228	336000	208772
22 nd Nov. planting	28.83	12	56000	36115	12560	38610	143285	345960	202675
7 th Dec. planting	19.78	12	56000	37907	16530	39013	149450	237360	87910
22 nd Dec. planting	14.70	12	56000	36760	18590	38394	149744	176400	26656

Conclusion

The yield of Diamont and Cardinal potato variety was higher under 22nd November planting, but the highest net profit was calculated in both varieties under 7th November planting due to lowest production cost. The economic return of 7th November planting was higher than other planting dates. The cost of production was gradually higher in case of late plantings due to use of higher amount of pesticides in the crop field. These pesticides were mainly used to protect late blight

disease, which was caused due to late plantings like 22nd November, 7th December and 22nd December. The crops planted late generally falls in the foggy, cloudy and comparatively warm weather in late February that favor late blight diseases, where early planting can escape this damage as crop may harvest before cloudy and comparatively warm weather in late February. It may be concluded that potato could be cultivated during 1st half of November month, after harvesting of short duration rice in October that will bring harvesting of potato in 1st

half of February, which can ensure highest net income from potato cultivation, and enables farmers to cultivate next crop like mungbean as an additional income. Thus from the economic point of view, potato cultivation may be recommended on 1st half of November which enables farmers to harvest potato within 1st week of February which can ensure highest net income from potato cultivation. After potato harvests, farmers may go easily for additional crop cultivation like mungbean in the month of February which requires only 60-70 days for harvesting.

Acknowledgements

The authors would like to thank RDRS for their very useful support to establish research activities at RDRS Farm, Rangpur and also thanks to Tuber Crops Research Center (TCRC), BARI for potato seeds support under this research program.

References

- Annual Report 2007-08. Effect of planting and harvesting time on the yield of processing variety. Islam, Seed Production and Research Activities, Breeder Seed Production Center, BARI, Debigonj, Panchagarh. PP.246–254.
- AMIS. 2016. Agriculture Market Information System in Bangladesh. Bangladesh Bureau of Annual Report (2007-08). Effect of planting and harvesting time on the yield of processing variety. Islam, Seed Production and Research Activities, Breeder Seed Production Center, BARI, Debigonj, Panchagarh. PP.246–254.
- Anonymous. 2008. International year of the world potato production, Available at <http://www.fao.org/potato-2008/en/beyond2008/index.html>
- Azad, T. F; A. K. Kabir; A. B. Siddique. 2017. Evaluation of six modern varieties of potato for yield, plant growth parameters and resistance to insects and diseases. *Journal of Agricultural Sciences*, Vol. (11), PP: 1315–1326. <https://doi.org/10.4236/as.2017.811095>
- BBS. 2000. Bangladesh Bureau of Statistics. Statistical Year Book of Bangladesh, Bangladesh Statistics Division, Ministry of Planning, Dhaka Bangladesh
- BBS. 2016. Yearbook of Agricultural Statistics-2016, Statistics and Informatics Division (SID), Ministry of Planning, Dhaka Bangladesh
- FAO, 2010. FAOSTAT. (<http://faostat.fao.org/>, Accessed July, 2010).
- Haque. 2010. Impact of rice-wheat/potato-mungbean cropping system of farmers' employment opportunity, food security and livelihood in selected munga-prone areas in northern districts of Bangladesh. Annual report submitted to KGF, BARC, Complex, Farmgate, Dhaka.
- Hussain M. M. 2008. Bangladesh Potato Campaign 2008. Prospects of potato in Bangladesh. Institute, Gazipur, Bangladesh.
- Islam, M., Mahfuz, M., Ghosh, S., Ali, A. and Hasnat, M. 2015. Improvement of potato based cropping patterns by inclusion of short duration Mungbean and T. Aman rice in Munga prone areas of Rangpur. *International Journal of Agricultural Research, Innovation and Technology*, 4(2), 35–40. <https://doi.org/10.3329/ijarit.v4i2.22645>
- Kabir, M.H., Alam M.K., Hossain M.A., Hossain M.M., Hossain M.J. 2004. Yield performance of whole-tuber and cut-piece planting of potato. *Journal of Tropical Sciences*, Vol.44(1), <https://doi.org/10.1002/ts.124>
- M. K. Alam, M. M. Zaman, M. I. Nazrul, M. S. Alam and M. M. Hossain. 2003. Performance of some exotic potato varieties under Bangladesh conditions. *Asian Journal of Plant Science*, Vol.2(1) PP:108–112. <https://doi.org/10.3923/ajps.2003.108.112>
- Krishi Projuki Hand Book 2017. Bangladesh Agricultural Research Institute.
- Prothom-Alo, 2015. The Daily Prothom-Alo, 30 October, 2015.
- Rahman M. M; M. A. Ali; T. K. Dey; K. M. Khalequzzaman; M. R. A. Mollah. 2007. Effect of planting time on incidence and development of late blight disease in four varieties of potato. *Bangladesh Journal of Agricultural Research* Vol.14(1), PP.81–90.
- Siddique, M. N. A; Sultana, J; Huda, M. S; Abdullah, M. R; Chowdury M. A. 2015. Potato Production and Management with Preference to Seed Potato Supply Chain, Certification and Actors Involve in Bangladesh, *International Journal of Business, Management and Social Research*, Vol.1(1), PP: 01–13 <https://doi.org/10.18801/ijbmsr.010115.01>
- Yearbook of Agricultural Statistics-2016. Bangladesh Bureau of Statistics (BBS), Statistics Division, Ministry of Planning. Dhaka Bangladesh.
- Uddin, A.B.M, M. Rahman, M. Alam and M. Sheikh 2015. Constraints and Strategies for Modern Varieties Potato Production Technology. *Bangladesh Journal of Agricultural Research*, Vol. 40(1) PP: 95–108. <https://doi.org/10.3329/bjar.v40i1.23763>

Meteorological Information in Rangpur district, 2014

January							February						
Date	Average Temperature (°C)		Total Rainfall (mm)	Average Relative Humidity (%)			Date	Average Temperature (°C)		Total Rainfall (mm)	Average Relative Humidity (%)		
	Maxi	Mini		Maxi	Mini	6:00 PM		Maxi	Mini		Maxi	Mini	6:00 PM
1 to 10	21	10	0	99	63	84	1 to 10	23	15	1	96	70	82
11 to 20	23	9	0	97	37	73	11 to 20	23	14	36	97	54	70
21 to 31	25	12	0	97	47	75	21 to 28	27	15	1	96	42	60
Rainfall 1 to 31			0				Rainfall 1 to 28			38			
March							April						
1 to 10	27	15	9	94	40	56	1 to 10	31	22	0	93	56	71
11 to 20	29	17	6	92	41	58	11 to 20	32	22	2	91	58	65
21 to 31	31	20	0	90	41	56	21 to 30	30	22	37	93	65	75
Rainfall 1 to 31			15				Rainfall 1 to 30			39			
May							June						
1 to 10	34	25	21	91	52	62	1 to 10	31	25	341	94	74	80
11 to 20	32	24	100	94	60	70	11 to 20	31	25	212	96	76	80
21 to 31	35	25	112	92	57	69	21 to 30	33	27	14	93	62	76
Rainfall 1 to 31			233				Rainfall 1 to 30			567			
July							August						
1 to 10	34	27	8	93	63	74	1 to 10	34	27	23	95	66	72
11 to 20	32	26	321	96	76	88	11 to 20	32	27	78	95	70	82
21 to 31	29	25	228	97	80	90	21 to 31	32	27	49	96	71	83
Rainfall 1 to 31			557				Rainfall 1 to 31			150			
September							October						
1 to 10	30	25	195	97	82	89	1 to 10	32	26	132	96	156	78
11 to 20	33	26	74	96	70	82	11 to 20	31	24	6	96	66	82
21 to 30	32	25	9	95	66	79	21 to 31	31	21	0	96	56	79
Rainfall 1 to 30			278				Rainfall 1 to 31			138			
November							December						
1 to 10	31	21	0	95	52	78	1 to 10	26	15	0	96	48	80
11 to 20	28	18	12	95	53	78	11 to 20	26	12	0	96	40	78
11 to 30	28	17	0	96	46	78	21 to 31	24	12	0	98	53	82
Rainfall 1 to 30			12				Rainfall 1 to 31			0			

Meteorological Information in Rangpur district, 2015

January							February						
Date	Average Temperature (°C)		Total Rainfall (mm)	Average Relative Humidity (%)			Date	Average Temperature (°C)		Total Rainfall (mm)	Average Relative Humidity (%)		
	Maxi	Mini		Maxi	Mini	6:00 PM		Maxi	Mini		Maxi	Mini	6:00 PM
1 to 10	25	12	0	97	47	80	1 to 10	23	12	0	95	50	70
11 to 20	23	12	0	97	55	81	11 to 20	23	11	1	93	42	63
21 to 31	19	12	37	95	59	76	21 to 29	27	14	1	94	40	58
Rainfall 1 to 31			37				Rainfall 1 to 29			2			
March							April						
1 to 10	28	16	26	95	51	65	1 to 10	29	19	40	93	51	61
11 to 20	29	19	0	90	49	60	11 to 20	32	22	1	93	55	65
21 to 31	30	20	22	93	56	67	21 to 30	32	23	3	91	62	69
Rainfall 1 to 31			48				Rainfall 1 to 30			44			

Grand Total Rainfall (1 January to 30 April) : 131