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Integrated crop management in potato through farmers' field school with special reference to women

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A B S T R A C T

Integrated Crop Management (ICM) study was done in 16 locations of 4 districts of Bangladesh with different potato varieties during 2009-10 and 2010-2011 potato growing seasons to find out the profitability level of ICM practice with farmers' practice. A study plot was set up in each location where Integrated Crop Management (ICM) practices recommended by the Tuber Crops Research Centre (TCRC) of BARI was followed in half of the plot and in the other half, Farmers' conventional Practices (FP) were followed. It was found in all locations that there were distinct differences between the ICM practice and the FP in respect of yield. In all locations except those of Bogra, farmers used fertilizers in higher doses than the recommended doses. Insecticides were not used even in the seed production plots in most of the study areas but fungicides were used in more than the recommended quantity resulting in misuse and environmental hazards. All farmers obtained lower yields in their practices than the ICM method. Incidences of different diseases were found to be higher in the FP plots than those of the ICM. Boric acid and bleaching powder had a positive effect in controlling scab and wilt, respectively. The farmers of Bogra and Comilla are likely to be benefited more by practicing ICM than those of the other districts. Benefit-Cost Ratio was higher in Munshiganj for ICM practice (2.77) on total cost basis and in Bogra for farmers' practice (4.63) on cash cost basis. Moreover, participating women members of Farmers' Field School (FFS) became economically benefited by making and selling potato chips that might leads them towards empowerment and social dignity.

Keywords: Farmers' Field School, potato ICM, women participation, Bangladesh

Introduction

In Bangladesh, the total area under potato cultivation is 0.318 million hectare with a total production of 4.35 million tones (Anon 2005). Although, potato is the third largest food as well as cash crop in our country, its average yield is only 13.6 t/ha, which is very low in comparison to other neighbouring countries. Among the reasons for the low yield of potato, lack of quality seed tubers, lack of improved varieties/practices and disease problems are noticeable (Hoque 1995). Farmers' Field School (FFS) is a new approach in Bangladesh that has been introduced in potato crop to overcome these constraints and ultimately to increase potato production more profitably and to keep the environment safe. The concept of FFS is that it is a school without wall, located in the field where farmers mainly learn about improved crop management practices (Ali 1998). Or in other words, potato FFS belongs to a group of potato farmer with common goal to improve their crop management practices. The objective of potato FFS is to introduce the farmers with the constraints of potato production and to make them equipped with the technologies so that they can overcome those constraints by themselves and can disseminate the knowl-

edge to the fellow farmers. Potato FFS is for ecology focused participatory learning to manage the important potato diseases/insects through integrated approaches. The major elements of FFS are a) a group of farmers, b) facilitator, c) meeting venue, d) study / trial plot and e) training / learning curriculum (Chowdhury & Ali 1999). In an FFS, the selected farmers can learn the different aspects of improve potato production practices, techniques of quality seed production, protecting the potato crop from different diseases / insects without disturbing the environment, economics of potato production in the improved and the conventional methods, practically.

FFS have been found as an effective approach towards increasing potato production in many countries like Indonesia, Nepal and Sri Lanka (Chowdhury & Hoque 2002) which need to be tested in Bangladesh. Moreover, for wider adoption of the FFS approach, it is also needed to demonstrate in the main potato growing areas among the farmers.

Therefore, the present study was designed with the objectives i) to know farmers' present potato production practices and to improve them by introducing potato ICM through FFS, ii) to expand the adoption of ICM potato through FFS and, iii) to compare the return of ICM practice with farmers' practice in potato production and to produce healthy potato crops adopting environment-friendly ICM approaches.

Materials and Methods

The trials were conducted in the farmers' field of 4 districts, namely Bogra, Comilla, Munshiganj and Rajshahi of Bangladesh. In each district, there were four Farmers' Field School (FFS) each having 25 selected farmers and a trial plot under the supervision of Tuber Crops Research Centre (TCRC) / Cooperation of American Relief Everywhere (CARE) staff. Each trial plot was of an area of 10 decimals (approximately 400 m^2), out of which 5 decimal was for ICM trial (improved production practices) and 5 decimal for farmers' practice (conventional practices) for potato production. Equal amount of seed tubers were used for ICM and farmers practices. Farmers in different districts except Bogra, cut the tubers into eye pieces but their spacing were very close in comparison to improved practices. Data were collected from the trial plots and the farmers. Purposive sampling technique was used to collect data from the farmers of the FFS areas. Mostly descriptive statistics were used in this study and only paired samples `t' test were computed from the collected data to observe the differences of variables under two conditions (ICM & FP) whether these were significant or not. To assess the comparative advantages of two conditions, partial budget analysis was carried out by calculating Total Variable Cost (TVC), Gross return, Total production costs, Benefit-cost ratio (BCR) etc. on full cost basis and

cash cost basis.

Benefit-Cost Ratio (BCR) was calculated with following formula:

$$\text{Benefit-Cost Ratio (Undiscounted)} = \frac{\text{Gross Return}}{\text{Total production costs}}$$

In different locations, for ICM plots, improved potato production practices were followed (TCRC recommended), which are given below:

Whole tubers @ 1.5 - 2.0 t/ha of the variety Diamant, Cardinal, Lal Pakri and Multa (in Bogra- Cardinal & Lal Pakri; in Comilla- Diamant; in Munshiganj- Diamant & Multa and in Rajshahi- Cardinal & Diamant) were planted maintaining a distance between rows 60 cm and between plants 25 cm. All the seeds were collected from the Bangladesh Agricultural Development Corporation (BADC) except Lal Pakri, which were collected from the farmer. Fertilizers were applied @ 330-220-250-120-14-6 kg of Urea, Triple Super Phosphate (TSP), Murate of Potash (MP), Gypsum, Zinc Sulphate and Boric Acid per hectare respectively. Full amount of TSP, MP, Gypsum, Zinc Sulphate, Boric Acid and half of the Urea were applied at the time of planting in the furrow and then properly mixed with the soil so that the tuber does not come in contact with the fertilizers. The remaining urea was applied at the time of earthing up. In addition to these, cowdung @ 20 t/ha was applied in 15 days before planting of tubers. Irrigation (2-4 times), weeding, earthing up and other intercultural operations were done as and when necessary for raising a good crop. The crop was sprayed with Dithane M-45/ Ridomil MZ 72 WP (@ 2g/L H_2O) and Dimecron (@ 1 ml/L H_2O) to prevent diseases and insects respectively. But in Rajshahi, farmers did not use insecticides or fungicides at all in the ICM plots. The dates of planting ranged from last week of November to middle of December and dates of harvesting ranged from last week of February to 3rd week of March. Prior to planting, the tubers were treated with boric acid and the soils were treated with bleaching powder. Regular rouging was practiced in the ICM plots and the haulm was pulled out before harvest. After harvesting, chips were made by female participants of the FFS following the procedure as described by Hoque (2009). Then the chips were stored in three different types of container viz., tin container, polybag and plastic container to assess their shelf life under natural condition.

The farmers' own practices that varied widely from location to location are summarized in Table 1.

Table 1.
Agronomic practices followed in different locations for raising potato

Operations	Locations			
	Bogra	**Comilla**	**Munshiganj**	**Rajshahi**
Variety	Lal Pakri	Diamant	Diamant	Cardinal/Diamant
Seed rate (kg/ha)	1500	1500-1700	1200-1500	1800-2000
Seed size	whole tuber	eye piece	eye piece	whole/cut tubers
Spacing	50 cm X 20 cm	45 cm X 12 cm	35 cm X 12 cm	45 cm X 15 cm
Sources of seeds	own	own	own	own + purchased
Fertilizers/ha				
Cowdung (MT)	10.0	10.0	occasionally	not used
Urea (Kg)	375	750	875-950	420-500
TSP (Kg)	180	988	875-950	250-700
MP (Kg)	150	988	800-825	250-375
Zypsum (Kg)	not used	not used	occasionally	120-175
$ZnSO_4$ (Kg)	not used	not used	occasionally	not used
Boric acid (Kg)	not used	not used	not used	not used
Application method	½ Urea+TSP+ MP at planting, ½ urea top dress	broadcast before planting of tubers	broadcast before planting of tubers	broadcasting before planting of tubers
Irrigation	4 times	twice	once	3-4 times
Weeding	done as required	done as required	done as required	done as required
Earthing up/Mulching	done	done	use only mulch	done
Fungicides used	Ridomil MZ 72 WP twice @ 5 g/L H_2O	Ridomil MZ 72 WP twice @ 3g/L H_2O	Ridomil MZ 72 WP thrice @ 3-4 g/L H_2O	Ridomil MZ 72 WP 2-4 times @2-4 g/L H_2O
Insecticides used	not reported	none	occasionally	0-2 times Basudin / Malathion (2.5ml/L)
Dates of Planting	23/11/01-2/12/01	22/11/01-8/12/01	Dec 7-12,2001	Nov 28- Dec 25, 01
Date of Harvesting	22/2/02-3/3/02	20/2/02-7/3/02	3/3/02-19/3/02	26/02/02- 26/03/02
Seed Treatment	not done	not done	not done	not done
Soil Treatment	not done	not done	not done	not done
Rouging	not practised	not practised	not practised	not practised
Haulm Killing	not practised	not practised	not practised	not practised

Results and Discussion

Results regarding yield in different locations are presented in Table 2. Results revealed that yield of potato in all the locations studied were significantly higher in ICM plots than the plots where farmers' own production technologies were practiced. This might be due to practice of improved methods of potato production. At Munshiganj, maximum yield was obtained in the ICM plot (30.0 t/ha) and the farmers' plots (27.25 t/ha) compared to other districts. This high yield in the farmers' field of Munshiganj was due to the use of comparatively good seeds. Potato growers are very much cautious about to get seed tubers from BADC or from other sources. Although, they do not practice the improved technologies of seed potato production but they are always

aware of this matter. Yield was very low at Bogra in both ICM plot (25.15 t/ha) and farmers plot (12.96 t/ha). This was due to the attack of late blight (20%) in the ICM plot and the use of local varieties and lower doses of fertilizers in the farmers plot. In Bogra and Comilla, there was distinct difference between the yield of ICM plot and farmers plot. Yield in ICM practice (26.98 t/ha) at Rajshahi was very close to the yield of farmers practice (26.11 t/ha). This might be due to use of some improved seeds along with farmers' own seeds in farmers practice. In all locations, although the farmers used high rate of fertilizers and other inputs but their yield was poor. Reason might be behind that they used inputs in nonscientific way. Hence, here lies a scope of increasing the yield of potato through the production of better quality seed tubers using improve technologies and to control diseases.

Regarding disease incidence, bacterial wilt was completely absent at Bogra and at Munshiganj, it attacked only in farmers plot, but at the rest two locations the disease appeared in both ICM and farmers plot (Table 3). The maximum infected plant with wilting was observed in farmers' plot (1.95%) at Comilla. It might be for the use of diseased seed and or from the infected soils. So, farmers' seed of Comilla district should not be used for the next year. The wilt infestation at Munshiganj (0.8%) was due to the use of diseased tubers. Because, in every year, soils of Munshiganj submerged by floodwater and there is a less chance of spreading the pathogen of bacterial wilt (*Ralstonia solanacearum*) by soils. In the ICM plots, less infection was observed as because the soils were treated with bleaching powder. From the Table 3, it was also observed that late blight (*Phytophthora infestans*) attacked at Bogra in both the ICM plot (20%) and farmers plot (15%). But at Munshiganj, the disease appeared only at the farmers' plot and the infestation was very low probably due to the cautiousness of farmers

Table 2.
Yield of ICM plot and farmers plot at different FFS in selected study areas, 2010-2011

Location	Yield range (t/ha)		Yield (t/ha)			't' value for Yield
	ICM plot	Farmers' practice	ICM plot	Farmers' practice	Mean	
Bogra	21.52-27.31	9.67-16.55	25.15[Z]	12.96	19.06	3.415*
Comilla	23.52-32.66	17.53-23.30	28.59	19.68	24.14	
Munshiganj	27.54-33.25	26.50-31.53	30.00	27.25	28.62	
Rajshahi	23.56-29.31	22.85-28.63	26.98	26.11	26.54	
Mean	24.04-30.63	19.14-25.00	27.68	21.50	24.6	

*Significant at 5% level, [Z]Yield of Cardinal considered.

about late blight disease. In all other locations, disease attack was not being reported (Table 3). The absence of late blight at Rajshahi and Comilla might be due to the absence of favourable weather conditions for late blight at those locations. Virus disease was reported only from the farmers' plot at Munshiganj but at Rajshahi, it was reported both from ICM and farmers' plot. Here lies a contradiction. The farmers of Rajshahi used Melathion twice and there should not attack of any virus carrying aphids. On the other hand, farmers of others locations did not use insecticides to control aphids and there was a chance of occurring viral diseases but no one reported viral infestation from those locations except Munshiganj. The infection of scab was very low in ICM plots than the farmers plot at Munshiganj. It indicates the effectiveness of boric acid against scab disease control. Similar observation regarding the effectiveness of boric acid against scab was reported by Rashid *et al.* (1999).

Regarding partial budget analysis, Table 4 reveals that in all the locations the production cost was higher in farmers' practice than ICM practice on full cost basis except Bogra. One of the important reasons was that the farmers of Bogra used lower amount of input like fertilizers than the recommended dose. But production cost was lower in farmers' practice than ICM practice on cash cost basis in all the locations. However, production cost was the highest in Comilla area on both full and cash cost basis in ICM practice as well as in farmers' practice than all other locations. This might be due to the use of higher amount of inputs in potato cultivation in Comilla. Highest gross return was obtained at Munshiganj (Tk. 165000.00/ha) when ICM was practiced and in case of farmers' practice, maximum return was also obtained from Munshiganj (Tk. 149875.00/ha). It might be due to the use of comparatively better seed and improve soil conditions. Every year the soils of Munshiganj become fertile due to flood. The difference between gross return of ICM and farmers' practice was higher in Bogra (Tk.

Table 3.
Disease incidence in ICM plot and farmers plot at different FFS in selected locations in 2010-2011

Location	Diseased plant (%)					
	Bacterial wilt		Late blight		Virus	
	ICM	FP	ICM	FP	ICM	FP
Bogra	-	-	20.0	15.0	-	-
Comilla	0.12	1.95	-	-	-	-
Munshiganj	-	0.80	-	0.50	-	2.00
Rajshahi	0.50	1.00	-	-	1.50	3.00

60945.00) and Comilla (Tk. 44525.00) than other two locations. This implies that the farmers of Bogra and Comilla would be more benefited than those of the other locations by practicing ICM. In case of benefit-cost ratio (BCR), it was higher in ICM practice than those of farmers' practice in all locations on full cost basis. But on cash cost basis, BCR

Table 4.
Partial budget analysis and benefit-cost ratio of potato production in two systems in different locations (in Tk. per ha)

Item	Locations							
	Bogra		Comilla		Munshiganj		Rajshahi	
	ICM	FP	ICM	FP	ICM	FP	ICM	FP
1. Human labour								
a) Hired	4850	3887	17850	21413	11250	16500	6750	6700
b) Family	3450	3050	5175	2625	1950	3000	4875	3050
2. Power tiller								
a) Hired	1950	1950	2100	2100	2150	2150	2000	2000
b) Family	-	-	-	-	-	-	-	-
3. Seed cost								
a) Purchased	22500	-	27750	-	22500	-	23925	11300
b) Own	-	13500	-	21450	-	18525	-	14050
4. Irrigation cost	560	700	2150	560	1600	240	1782	920
5. Manure cost								
a) Purchased	3000	1100	650	450	2500	-	1000	-
b) Own	2000	1400	4350	2050	2500	-	4000	-
6. Fertilizer cost	5593	5415	5593	23272	5593	22322	5593	12454
7. Pesticide cost	881	953	4482	4680	2872	5213	-	4212
8. Mulch cost (own)	-	-	-	-	-	1000	-	-
9. Interest on cash investment @ 10% for 4 months	1311	467	2019	1749	1616	1548	1368	1253
10. Total variable cost	46095	32422	72119	80349	54531	70498	51293	55939
a) Total cost basis	39334	14005	60575	52475	48465	46425	41050	37586
b) Cash cost basis	4739	4739	5231	5231	5106	5106	4598	4598
11. Land rent (cash rent for the season)	50834	37161	77350	85580	59637	75604	55891	60537
12. Production cost								
a) Total cost basis	39334	14005	60575	52475	48465	46425	41050	37586
b) Cash cost basis	125784	64839	142950	98425	165000	149875	134990	130550
13. Gross return	(25.15)	(12.97)	(28.59)	(19.68)	(30.00)	(27.25)	(26.98)	(26.11)
14. Benefit-Cost Ratio								
a) Total cost basis	2.47	1.74	1.85	1.15	2.77	1.98	2.41	2.16
b) Cash cost basis	3.20	4.63	2.36	1.88	3.40	3.23	3.29	3.47

- Figures in parenthesies indicates yield (t/ha)
- Price of produced potato per kg: Munshiganj= Tk. 5.5 and other locations = Tk. 5.0
- Seed potato per kg: BADC= Tk. 15/-, Farmers= Tk. 13/- and Lal Pakri= Tk. 11/-; Labour: Tk. 75/- per day per head but in Bogra: Tk. 50/- per head per day, Price of fertilizers/manures (per kg): Urea Tk. 6/-, TSP: Tk. 10/50, MP: Tk. 8/50, Zypsum: Tk. 3/50, $ZnSO_4$: Tk. 60/-, Boric acid: Tk. 80/- and Cowdung: Tk. 0/25.

was higher in ICM practice than farmers' practice only in Comilla and Munshiganj and lower in two other locations. Overall, BCR was higher in Munshiganj (2.77 for ICM practice) on full cost basis and in Bogra (4.63 for FP) on cash cost basis.

Results regarding quality of chips in different potato varieties are presented in Table 5. While comparing the quality of chips, it was found that peeling loss in the variety BARI TPS-1 was the highest (15.1%), which was statistically similar with the loss found in the varieties Felsina (13.8%) and Granola (14.4%). Peeling loss was the lowest in the variety Esprit (9.9%). Generally, it was observed that peeling loss was high in the variety which has deep eye depth compared to shallow eye depth. Regarding weight of dry chips per kg of tubers, the variety Lady Rosetta produced the highest amount of dry chips (193.4 g/kg of tubers), which was statistically different with other varieties. Varieties that produced around or more than 170 g dry chips/kg of tuber included Asterix (167.3g), Courage (183.6g), Diamant 166.7g), Esprit (165.4g), Felsina (173.3g) and Lady Rosetta (193.4g). Results regarding chips preparation from different varieties of potato have been presented (Anonymous (2008 and 2009). In case of colour of dried chips, the variety Lady Rosetta produced whitish, BARI TPS1 and Cardinal produced light whitish coloured chips, while all other varieties produced light golden coloured chips. Amount of moisture present in dried chips is an important factor as it determines the shelf-life of dried chips.

Table 5.
Quality of chips in different varieties of potato at Munshiganj (average of 2 years trial)

Variety	Peeling loss (%)	Wt. of dry chips (g)/kg tuber	Colour of dry chips	Moisture in dry chips (%)	Colour of fried chips	Crispiness
Asterix	11.2 ef	167.3 cd	LG	7.0 d	LG	Crispy
BARI TPS-1	15.1 a	137.2 f	LW	9.4 a	G	Moderately
Cardinal	13.1 bc	162.0 de	LW	7.4 cd	LG	Crispy
Courage	11.5 de	183.6 b	LG	7.7 bc	LG	Crispy
Diamant	12.6 cd	166.7 cd	LG	7.9 bc	G	Crispy
Esprit	9.9 f	165.4 cd	LG	7.9 bc	G	Crispy
Felsina	13.8 abc	173.3 c	LG	7.4 cd	LG	Crispy
Granola	14.4 ab	163.9 cde	LG	8.2 b	SB	Crispy
Lady Rosetta	12.6 cd	193.4 a	W	7.8 bc	LW	Crispy
Provento	12.9 c	154.7 e	LG	7.8 bc	LG	Crispy
Mean	12.7	166.8	-	7.84	-	-
CV(%)	6.01	3.07	-	4.38	-	-
$LSD_{0.05}$	1.309	8.782	-	0.5893	-	-

Means followed by same letter(s) in the same column do not differ significantly at 5% level by DMRT
Colour: LG= Light Golden, LW= Light Whitish, G= Golden, W= Whitish, SB= Slightly Brown

Highest amount of moisture is not desired because it shortens shelf-life. However, maximum amount of moisture was found in the chips of the variety BARI TPS-1 (9.4%) followed by Granola (8.2%) and minimum (7.0%) in the variety Asterix with an average of 7.84%. Chips of the varieties possess moisture lower than the average included Asterix (7.0%), Cardinal (7.4%), Courage (7.7%), Felsina (7.3%), Lady Rosetta (7.9%) and Provento (7.9%). Colour of fried chips in majority of the varieties was either golden or light golden. Colour of fried chips in Lady Rosetta was light whitish while, in Granola, the colour was slightly brown. Fried chips in all the varieties were crispy except BARI TPS -1, where the fried chips were moderately crispy. In fried chips, colour of chips made from Granola was slightly brown and crispiness in chips made from BARI TPS-1 was moderately crispy. This might be due to higher amount of moisture present in the dried chips. Usually, high moisture results in deterioration of quality (Cruess 1997).

Chips made from the potato variety Asterix were stored in three types of container viz. polybag, tin container and plastic container. The collected data after proper analysis have been presented in Table 6, 7, 8, 9 and 10. Regarding water percentage, it was observed that water in fresh dried chips was 6.2%, which increased with the increase of storage period. But at 120 and 240 days after storage, the preserved chips were sun dried and average amount of water was then comes to 6.3% and 6.8%, respectively (Table 6). Although, amount of water in all the treatments were statistically non-significant but it was lower in plastic container in all days after storage. This might be due to non-movement of air from outside to the inside of the plastic container. On the contrary, little air movement probably occurred in the poly bag and opening portion of the tin container where separate lid was attached. When the dried preserved chips were fried then the ratio of fried and dried chips were calculated. The ratio indicates that how much oil is consumed by the dry chips when they are fried. The lower ratio of fried and dried chips is expected. However, the ratio of fried and dried chips was statistically non-significant in all the treatments. But the ratio was lower in case of plastic container in comparison poly bag and tin container (Table 7). Colour of dried preserved chips started to show variation among the treatments after 210 days of storage. Initially, during first preservation, the entire dried chips colour was light golden. In the plastic container this light golden colour turned to slightly brown after 360 days of storage and at that time chips colour turned to brown in other two treatments (Table 8). Deterioration of chips colour in the tin containers started earlier (210 DAS) which might be due to heat evolved inside the container rapidly than poly bag or plastic container and moisture absorption through the lid. Similar finding was also reported by Cruess (1997). He reported that vegetables must be dried to low moisture content and the package must protect them against absorption of moisture; otherwise the vegetables discolour and

rapidly deteriorate in quality. More or less similar findings were observed in case of colour of fried chips (Table 9). While observing the crispiness of the fried chips, all the chips in all treatments were found crispy (Table 10). Therefore, plastic container is better for preservation of dried chips and chips can be preserved in the plastic containers up to 1 year. This is in agreement with the findings of Hoque *et al*. (2008) and Huq (2001). In another report, it is stated that dried chips made from potato remains good for more than 1 year and these chips were fried and tested every month and found good in colour, crispiness and taste upto 1 year of shelf-life (Anon 2002).

Table 6.
Percentage of water in dried chips in different types of container at different days after storage (DAS) at Munshiganj

Treatment	% water												
	Fresh	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	210 DAS	240 DAS	270 DAS	300 DAS	330 DAS	360 DAS
Poly Bag	6.2	8.4	9.3	11.2	6.3	8.3	8.8	9.9	6.8	9.7	10.4	11.1	11.6
Tin Container	6.2	7.8	8.3	9.7	6.3	7.8	8.0	10.4	6.9	10.0	11.1	11.2	11.7
Plastic Container	6.2	7.7	8.0	9.2	6.2	7.4	7.8	9.7	6.8	9.5	10.0	10.2	10.6
Mean	6.2	8.0	8.5	10.0	6.3	7.8	8.2	10.0	6.8	9.7	10.5	10.8	11.3
CV%	0.62	10.28	6.65	5.01	4.42	12.39	8.59	8.14	13.51	6.14	7.04	7.34	6.85
$LSD_{0.05}$	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Table 7.
Raito of fried and dried chips in different types of container at different days after storage (DAS) at Munshiganj

Treatment	Fried chips : dried chips												
	Fresh	30 DAS	60 DAS	90 DAS	120 DAS	150 DAS	180 DAS	210 DAS	240 DAS	270 DAS	300 DAS	330 DAS	360 DAS
Poly Bag	1.24	1.18	1.15	1.11	1.12	1.07	1.05	1.09	1.05	1.07	1.03	1.08	1.07
Tin Container	1.20	1.19	1.11	1.12	1.18	1.09	1.07	1.06	1.08	1.12	1.09	1.07	1.10
Plastic Container	1.21	1.14	1.11	1.11	1.10	1.08	1.08	1.07	1.06	1.06	1.05	1.06	1.06
Mean	1.22	1.17	1.12	1.11	1.13	1.08	1.07	1.07	1.06	1.08	1.06	1.07	1.08
CV%	3.44	3.29	2.70	5.85	5.50	4.62	6.76	2.52	3.80	4.44	7.04	4.23	6.96
$LSD_{0.05}$	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Table 8.
Colour of dried chips in different types of container at different days after storage (DAS) at Munshiganj

Treatment	Colour of dried chips												
	Fresh	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**150 DAS**	**180 DAS**	**210 DAS**	**240 DAS**	**270 DAS**	**300 DAS**	**330 DAS**	**360 DAS**
Poly Bag	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG & SB	SB	SB & B	B
Tin Container	LG	LG	LG	LG	LG	LG	LG	LG & SB	LG & SB	SB & B	B	B	B
Plastic Container	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG & SB

LG= Light Golden, SB= Slightly Brown, B= Brown

Table 9.
Colour of fried chips in different types of container at different days after storage (DAS) at Munshiganj

Treatment	Colour of fried chips												
	Fresh	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**150 DAS**	**180 DAS**	**210 DAS**	**240 DAS**	**270 DAS**	**300 DAS**	**330 DAS**	**360 DAS**
Poly Bag	LG	LG	LG	LG	LG	LG	LG	LG	LG & SB	SB	SB	SB & B	B
Tin Container	LG	LG	LG	LG	LG	LG	LG	SB	SB	SB	B	B	B
Plastic Container	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG	LG & SB

LG= Light Golden, SB= Slightly Brown, B= Brown

Table 10.
Crispiness of fried chips in different types of container at different days after storage (DAS) at Munshiganj

Treatment	Crispiness												
	Fresh	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**150 DAS**	**180 DAS**	**210 DAS**	**240 DAS**	**270 DAS**	**300 DAS**	**330 DAS**	**360 DAS**
Poly Bag	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy
Tin Container	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy
Plastic Container	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy	Crispy

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