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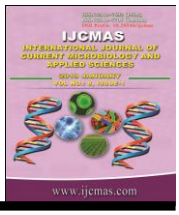

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Studies of Some Important Pests on Potato Germplasms and their Integrated Management

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A B S T R A C T

The study was carried out during rabi season, 2007-2008 at the Adisaptagram Block Seed Farm, Department of Agriculture, Government of West Bengal. Eight germplasms were chosen for the experiment the studied on mainly soil pests *viz.*, cutworm, mole cricket and the storage pest potato tuber moth (PTM). Kufri anand was found highest health tubers.

Introduction

Potato is grown in almost all the states in India under various seasonal conditions. Nearly 90% of potatoes are grown in the vast Indo-Gangetic plains of North India during short winter days from October to March. About 6% area under potato cultivation is in the hills, where it is grown during long summer days of April to October and the plateau region of south eastern, central and peninsular India constitutes about 4% area, where potato is grown as a rainfed kharif crop during rainy season (July- October) or as an irrigated rabi crop during winter (October-March). Among the states, Uttar Pradesh, West Bengal and Bihar accounted for nearly 71% area and 76% production of the country (Chadha, 2002). In West Bengal potato is the most important food crop, next to cereals and the states ranks second position in area (310.97 mill. ha) and production (7281.67 mill. Tonnes) but, first productivity (23.42 t/ha) in the country (Raj 2003). Earlier its cultivation was largely confined to the Districts of Hooghly, Burdwan and Midnapore, but with the increasing facilities of irrigation, introduction of high yielding early varieties, well integrated management of pest and diseases and development of suitable agronomic practices, potato cultivation is gradually being extended to others Districts of West Bengal (Anonymous, 2001).

Cutworm [*Agrotis* spp. (Noctuidae: Lepidoptera)] and mole cricket [*Gryllotalpa africana* (Gryllotalpidae:orthoptera)] comes under soil pests of potato. The important ones, while potato tuber moth [*Pthorimaea operculella*, (Zeller) (Gelehiidae: Lepidoptera)] is only storage pests of potato.

Materials and Methods

The experiment was carried out at the Adisaptagram Block Seed Farm, Department of Agriculture, Government of West Bengal, Mogra, Hooghly, West Bengal during rabi season of November, 2007 to March, 2008. Eight potato germplasms viz., Kufri Chipsona-1, Kufri Chipsona-2, Kufri Chandramukhi, Kufri Jyoti, Kufri Anand, Atlantic, Kufri Surya and Kufri Pankaj were collected from different sources and the experiment was laid out in Randomized Block Design (RBD) with three replications of eight genotypes.

The plot size was kept 6m ×2m with 60 cm row and 20 cm intra row spacing. 15 randomly selected plants were taken per treatment per replication. The population of pest was recorded 100 leaf index method followed by Sympson (1940).

Results and Discussion

Screening for different insect pests or resistance

Eight germplasms of potato were screened for different insect pests resistance. Out of these eight germplasms, seven were released from central Potato Research Institute (ICAR), Shimla, Himachal Pradesh, India and the remaining one i.e. Atlantic was originated from Atlanta, Canada.

In the present experiment more or less similar type of insects pests were found to infest different potato germplasms (Table 1).

Percent plant damage caused by different soil pests on different potato germplasms

In the present experiment, it was recorded that the soil pests viz., cutworm (Agrots spp.) and mole cricket (*Gryllotalpa africana* P.de Beau.) played an important role in damaging the shoots of the crop along with the tubers. Hence, the percentage of plant (shoot) damage caused by the soil pests on different potato germplasms was studied systematically.

The data, presented in table 2, indicated that during the crop season from November, 2007 to March, 2008, the plant emergence was varied from 88.33% in Kufri Chipsona-2 to 94.66% in Kufri Anand at 30 days after planting (DAP). In this parameter, Kufri Chandramukhi (92.33%) and Kufri Chipsona-1 (91.33%) performed better than Kufri Pukhraj (88.66%), Kufri Chipsona-2 (88.33%) and Kufri Surya (84.33%). But total number of healthy shoots per plot was found maximum in Kufri Anand (471.33) followed by Kufri Chandramukhi (443.33), Atlantic (435.66), Kufri Surya (431.33), Kufri Pukraj (422.66), Kufri Chipsona-1 (417.33), Kufri Jyoti (416.66) and Kufri Chipsona -2 (398.66), respectively. The number of damaged shoots (per plot), caused by soil pest, was recorded lowest in Kufri Chipsona-1 (33.33) and then it was gradually increased in Kufri Jyoti (33.33), Kufri chandramuhi (40.33), Atlantic (41.33), Kufri Chipsona-2 (44.66), Kufri Pukhraj (46.33) and Kufri Surya (49.33), respectively. The percent plant damaged, caused by cutworm and mole cricket together, was varied from one germplasms to another. Further it has also been noted that maximum percentage of plant was noticed during early stage of growth as compared to later stage. Ram *et al.*, (2001) also recorded greater percentage of plant damage, caused by cutworm, in between third week of December to second week of January.

The percent plant (shoot) damage was found higher in Kufri Surya (10.26%) followed by Kufri Chipsona-2 (10.07%), Kufri Pukhraj (9.87%) in Kufri Chipsona-1 (7.39%). But in case of Kufri Jyoti (8.42%), Kufri Chandramukhi (8.33%) and Kufri Anand (8.29%), moderate to higher percentage of plant damage was recorded. These findings are in agreement with those, reported earlier by Ram *et al.,* (2001), who obtained greater percentage of plant damage in Kufri Badsha, Kufri Chandramukhi and Kufri Jyoti.

Yield of different potato germplasms

The yield of different potato germplasms were evaluated, both on number and weight basis, during harvesting of the crop and it has been observed that a considerable amount of tubers were damaged by different pests viz., cutworm (*Agrotis* spp.), mole cricket (*Gryllotalpa africana* P.de Beau.), potato tuber moth or PTM (*Phthorimaea operculella* Zell.) and rats. The susceptibility of different potato germplasms to these pests were also assessed categorically. Thus the results on yield of healthy and damaged tubers of different germplasms during potato growing season i.e., November, 2007 to March, 2008 presented in Table 3.

The data shown in table 3, indicated that the number of healthy tubers was recorded highest in Kufri Chipsona-1 (780.33) followed by Kufri Anand (766.00), Kufri Chipsona-2 (749.00), Atlantic (731.33), Kufri Pukhraj (729.33), Kufri Surya (701.33), Kufri Jyoti (628.66) and Kufri Chandramukhi (591.33), respectively. But an weight per plot basis, the yield of healthy tubers was found maximum in Kufri Anand (32.90Kg), which was closely followed by Atlantic (29.50 Kg), Kufri Jyoti (27.33 kg), Kufri Surya (25.80 kg), Kufri Pukhraj (24.50 kg), Kufri Chipsona-1 (23.66 kg) Kufri Chandramukhi (22.66 kg) and Kufri Chipsona-2 (19.95 kg), respectively. Among these potato germplasms it may be concluded that Kufri Anand recorded the highest yield of potato tuber (27.40 t/ha), followed by Atlantic (24.58t/ha), Kufri Jyoti (22.77 t/ha), Kufri Surya (21.50 t/ha), Kufri Pukhraj (20.41 t/ha) Kufri Chipsona-1 (19.71 t/ha), Kufri Chandramukhi (18.88 t/ha) and Kufri Chipsona-2 (16.62 t/ha), respectively.

The findings of Pal and Konar (2006) are more or less similar to the result of the present investigation. However, significant differences were also observed in the level of tuber damage (number and weight basis) by the different pests. Cutworm was the most important pests as it was damaged a large amount of potato tubers ranging from 38.0 per plot in Atlantic to 103.66 per plot in Kufri Chipsona-2 on number basis and 4.70 kg/plot in Kufri Chipsona-1 to 7.40 kg/plot in Kufri Anand on weight basis.

On weight basis maximum tuber damaged was found in Kufri Anand (7.40 kg/ plot) which was followed by Kufri Chipsona -2 (7.13), Kufri Surya (5.90), Kufri Pukhraj (5.33), Kufri Chandramukhi (5.30 kg), Kufri Jyoti (5.20 kg), Atlantic (4.80 kg)and Kufri Chipsona-1 (4.70 kg) respectively. From the study it can be stated that Kufri Anand and Kufri Chipsona-2 were highly susceptible to this pests, while Kufri Chipsona-1 and Atlantic were less susceptible and the rest i.e. Kufri Jyoti, Kufri Chandramukhi, Kufri Pukhraj and Kufri and Kufri Surya were moderately susceptible to the soil pests. Both on number and weight basis, the mole cricket damage tubers were found maximum in Kufri Chipsona-2 (28.66 and 2.85 kg/plot, respectively) and minimum in Kufri Anand (10.66 and 1.40 kg/plot, respectively). On the other hand PTM (potato tuber moth) did not cause damage to the tuber of all potato germplasms. The damage of PTM was observed in KufriChipsona-2 (0.72 kg/plot), Kufri Chandramukhi (0.30 kg) except Kufri

Surya and Kufri Anand. From the present investigation, it could not be possible to conclude that Kufri Surya and Kufri Anand were resistant and other were susceptible to the pests as the damage in different germplasms was almost negligible. The rate damage was significantly variable from one germplasms to another. On number basis, the rat damage tuber (per plot) was varied from 10.66 in Kufri Chipsona-2 to 25.33 in Kufri Jyoti, while on weight basis, it was ranged from 0.65 kg/plot in Kufri Chipsona-2 to 2.00 kg/plot in Kufri jyoti.

Therefore, the total tuber damage (number basis) was found maximum in Kufri Chipsona-2 (150.64 per plot) and minimum in Atlantic (75.32 per plot) and regarding the weight of total damage tubers (per plot), Kufri Chipsona-2 (11.35 kg) ranked first and then Kufri Jyoti (10.45 kg), Kufri Anand (9.35 kg), Kufri Surya (8.95 kg), Kufri Chipsona-1 (8.65 kg) and Atlantic (8.05 kg), respectively.

It is, therefore, evident from the present field trial that Atlantic yielded maximum percentage of healthy tuber (78.56%) and then in the order were Kufri Anand (76.16%), Kufri Surya (74.24%) Kufri Chipsona-1 (73.23%) Kufri Jyoti (72.34%), Kufri Chandramukhi (70.80%), Kufri Pukhraj (70.44%) and Kufri Chipsona-2 (63.74%) respectively. Similarly, total tuber yield including healthy and damaged were also highest in Kufri Anand (36.00 t/ha), followed by Kufri Jyoti (31.48t/ha), Atlantic (31.29 t/ ha), Kufri pukhraj (28.98 t/ha), Kufri Surya (28.95 t/ha), Kufri Chipsona-1 (26.92 t/ha), Kufri Chandramukhi (26.67 t/ha) and Kufri Chipsona-2 (26.08 t/ha), respectively.

Efficacy of insecticidal treatment scheduled against potato insect pests

In the present experiment the treatment schedules were T_1, T_2, T_3, T_4 and T_5. Both chemical and non-chemical insecticides were uses to control insecticides of potato.

Per cent damage caused by soil pests on potato under different treatment schedules

The plant damaged caused by soil pests viz., cutworm and mole cricket was worked out different treatment schedules during crop growing season from November, 2007 to March, 2008, and the results obtained have been shown in table 4. It is evident from the table that, the plant emergence in all treatments were statistically significant over control and maximum plant was found in T_4 (95.75%), which was followed by T_3 (91.25%), T_5 (90.75%), T_2 (89.75%) and T_1 (88.50%) respectively.

The number of healthy shoots per plot was significantly different among the five treatment schedules. It was found highest in T_3 (475.50) followed by T_2 (465.25), T_4 (462.25), T_5 (458.75) and T_1 (425.50) respectively. Consequently, T_3 gave minimum number of damage shoots per plot (31.25), which was followed by T_2 (33.25), T_4 (34.50), T_5 (38.75) and T_1 (46.25) respectively. Among this T_3, T_2 and T_4 were at par with each other. Therefore, on the basis of percent plant (shoot) damage, T_3 was most effective in reducing the damage (6.16%) and then in order were, T_2 (6.67%), T_4 (6.94%), T_5 (7.78%) and T_1 (9.80%), respectively.

Therefore, it is evident from percentage investigation the plant emergence affected by different schedules. The number of healthy shoots as well as damage shoots was significantly influenced by the schedules and as a results, the percent plant (shoots) damage was significantly different from one treatment to another. It has been observed that the percentage of plant damage was minimum in T_3 (6.16%) and maximum in T_1 (9.80%). Because in T_3 the crop was protected from

planting to harvesting by chemical insecticides, which were both contact (chloropyriphos) and systematic (phorate and imidacloprid) in nature. Konar et al, (2003) also recorded lowest plant damage, when the crop was treated with phorate as well as chloropyrihos individuals, T_3 and T_2, was most effective against the pest due to application of chemical insecticides during early growth stage, when the intensity of damage by the soil pest (cutworm) was high. On the other hand maximum plant damage caused by soil pests was found in T_4 and T_5 as compared to T_3 and T_2 but T_4 (6.94%) is slightly better than T_5 (7.78%). This is because of the fact that in T_4 application chemical insecticides Imidacloprid and chloropyriphos along with two biopesticides i.e. azadirectin and Bacillus thuringiensis was done, whereas in T_5 application of biopesticides only from plating to harvesting. It is also evident from present investigation the treatment schedules, which were consisting of mainly bio-pesticides, were not so effective in reducing the plant damage caused by soil pests. The findings of the presents study are in agreement with thereof reported earlier by Konar *et al.,* (2003), Konar and Chetri (2003). Mohasin *et al.,* (1993) and Tripathi *et al.,* (2003) also obtained better results, when the crop was sprayed with chloropyriphos 20EC @ 1.0 kg a.i/ha.

Yield of potato tubers under different treatment schedules

The damage, caused by different soil pest like cutworm, mole cricket, potato tuber moth (PTM) and rat, under different treatment schedules was recorded at the time of harvesting of potato tubers and the data collected were statistically analyzed. During field study from November, 2007 to March, 2008, it has been observed that all the schedules were significantly superior over control in reducing the damage by these pests (Table 5). The number of healthy tubers per plot was found maximum in T_2 (458.0), which was succeeded by T_4 (398.0), T_3 (385.50), T_5 (368.50) and T_1 (281.50), respectively. On weight basis, T_3 (18.70 kg/plot), T_4 (16.75 kg/plot), T_5 (15.25 kg /plot) and T_1 (11.25 kg/plot), respectively. Among different treatment schedules, the cutworm damage per plot was recorded minimum in T_2 (12.50) and then in T_3 (13.25), T_4 (15.50), T_5 (18.25) and T_1 (35.0), respectively on number basis, while on weight basis the least damage per plot was obtained in T_3 (1.25 kg), followed by T_2 (1.50 kg), T_4 (1.75 kg), T_5 (2.50 kg) and T_1 (3.5 kg) respectively. The cutworm damage (weight basis) in T_3, T_2 and T_4 were at per among themselves. However, the mole cricket damage (number basis) was recorded maximum in T_1 i.e. control (10.25/plot) which was followed by T_5 (8.5/plot), T_4 (7.0/plot), T_2 (5.50/plot) and T_3 (4.25/plot) respectively. On weight basis the maximum damage per plot was observed in T_1 (1.25 kg), followed by T_5 (1.0 kg), T_4 (0.75 kg), T_3 (0.50 kg) and T_2 (0.50 kg) respectively. In addition to this, weight of damaged (by mole cricket) potato tubers in T_2 and T_3 was similar as well as per among themselves.

The PTM damage was noticed in T_4, T_5 and T_1, which was ranged from 1.25- 2.00 per plot on number basis and 0.25 kg -0.50 kg /plot on weight basis. However, the rat damaged was recorded in all the schedules, which was significantly different from each other on weight and number basis. On number basis the maximum damaged tuber by rat was in T_1 (20.50 /plot), followed by T_5 (17.50/plot), while on weight basis maximum damage also T_1 (2.5 kg/plot), followed by T_4 and T_5 (1.25 kg/plot), T_2 (1.0 kg/plot) and T_3 (0.75 kg/plot) respectively. Thus the total number of damage was recorded minimum in T_3 (28.50/plot) and then in T_2 (32.00/plot), T_4 (39.0/plot), T_5 (45.75/plot) and T_1 (67.75/plot) which is under control.

Table.1 List of insect pests

Common name	Scientific Name	Family	Order
4.Cutworm	Agros spp.	Noctuidae	Lepidoptera
5.Mole cricket	Gryllotalpa africana P.de Beau.	Gryllotalpidae	Orthoptera
6.Potato tuber moth (PTM)	Pthorimaea operculella (Zellar)	Gelchidae	Lepidoptera

Table.2 Per cent plant damage caused by soil pests (cutworm and mole cricket together) on different germplalsms

Different germplasms	Percent plant emergence	Total number of shoots (per plot)		Percent plant (shoot) damage
		Healthy	Damaged	
Kufri Chipsona-1	91.33 (72.88)	417.33 (20.43)	33.33 (5.77)	7.39 (15.78)
Kufri Chipsona-2	88.33 (70.03)	398.66 (19.97)	44.66 (6.68)	10.07 (18.50)
Kufri Chandramukhi	92.33 (73.93)	443.33 (21.06)	40.33 (6.35)	8.33 (16.78)
Kufri Jyoti	93.66 (75.43)	416.66 (20.41)	38.33 (6.19)	8.42 (17.02)
Kufri Anand	94.66 (76.66)	471.33 (21.71)	42.66 (6.53)	8.29 (16.74)
Atlantic	93.00 (74.68)	435.66 (20.87)	41.33 (6.43)	8.66 (17.12)
Kufri Surya	84.33 (66.68)	431.33 (20.77)	49.33 (7.02)	10.26 (18.68)
Kufri Pukhraj	88.66 (70.33)	422.66 (20.56)	46.33 (6.81)	9.87 (18.32)
SEm(±)	0.42	0.01	0.03	0.09
CD 0.05	2.17	0.06	0.17	0.47

Figure in parenthesis are angular (in case of parent data) and square root (in case of general data) transformed values plot size = 12 sq. M

Table.3 Yield of different potato germplasms

Different germplasms	Damaged tubers (per plot)													
	Healthy tubers		Yield (t/ha)	Cutworm		Mole cricket		PTM		Rat		Total		Yield (t/ha)
	Number	Weight (Kg)		Number	Weight (Kg)	Number	Weight (Kg)	Number	Weight (Kg)	Number	Weight (Kg)	Number	Weight (Kg)	
Kufri Chipsona-1	780.33	23.66	19.71	62.00	4.70	19.33	2.50	3.33	0.20	20.66	1.25	105.32	8.65	7.20
Kufri Chipsona-2	749.00	19.95	16.62	103.66	7.13	28.66	2.85	7.66	0.72	10.66	0.65	150.64	11.35	9.45
Kufri Chandramukhi	591.33	22.66	18.88	41.33	5.30	19.66	2.50	5.33	0.30	22.66	1.25	88.98	9.35	7.79
Kufri Jyoti	628.66	27.33	22.77	48.00	5.20	21.66	2.50	5.66	0.75	25.33	2.00	100.65	10.45	8.70
Kufri Anand	766.00	32.90	27.41	70.33	7.40	10.66	1.40	0.00	0.00	11.66	1.50	92.65	10.30	8.58
Atlantic	731.33	29.50	24.58	38.00	4.80	15.33	1.50	3.66	0.25	18.33	1.50	75.32	8.05	6.70
Kufri Surya	701.33	25.80	21.50	81.66	5.90	20.33	2.25	0.00	0.00	11.00	0.80	112.99	8.95	7.45
Kufri Pukkhraj	729.33	24.50	20.41	58.66	5.33	21.66	2.80	4.66	0.70	19.00	1.45	103.98	10.28	856
SEm(±)	0.55	0.67	-	0.51	0.46	0.71	0.42	0.30	0.16	0.56	0.36	1.07	0.59	-
CD 0.05	2.87	3.49	-	2.62	2.40	3.68	2.16	1.58	0.82	2.93	1.89	5.55	3.04	-

Plot size = 12sqm. , SEm = Standard Error Mean, CD = Critical Difference, PTM = Potato Tuber Moth

Table.4 Per cent plant damage caused by soil pests (cutworm and mole cricket together) on potato under different treatment schedules

Treatment schedules	Percent plant emergence	Total number of shoots (per plot)		Percent plant (shoot) damage
		Healthy	Damaged	
T_1	88.50 (70.19)	425.50 (20.63)	46.25 (6.80)	9.80 (18.24)
T_2	89.75 (71.35)	465.25 (21.57)	33.25 (5.76)	6.67 (14.96)
T_3	91.25 (72.81)	475.50 (21.80)	31.25 (5.59)	6.16 (14.37)
T_4	95.75 (78.16)	462.25 (21.49)	34.50 (5.87)	6.94 (15.27)
T_5	90.75 (72.31)	458.75 (21.41)	38.75 (6.22)	7.78 (16.20)
SEm(±)	0.62	0.04	0.04	0.09
CD 0.05	1.90		0.01	(0.30)

Figures in parenthesis are angular (in case of parent data) and square root (in case of general data) transformed values

Plot size = 7.2 sq. m. , , SEm = Standard Error Mean, CD = Critical Difference

Table.5 Yield of potato tubers (number and weight basis) under treatment schedules

Treatment schedules	Damaged tubers (per plot)												
	Healthy tubers per plot		Yield (t/ha)	Cutworm		Mole cricket		PTM		Rat		Total		Yield (t/ha)
	Number	Weight (Kg)		Number	Weight (Kg)	Number	Weight (Kg)	Number	Weight (Kg)	Number	Weight (Kg)	Number	Weight (Kg)	
T_1	281.50	11.25	15.62	35.00	3.50	10.25	1.25	2.00	0.50	20.50	2.50	67.75	7.75	10.76
T_2	458.00	18.10	25.14	12.50	1.50	5.50	0.50	0.00	0.00	14.00	1.00	32.00	3.00	4.16
T_3	385.50	18.70	25.97	13.25	1.25	4.25	0.50	0.00	0.00	11.00	0.75	28.50	2.50	3.47
T_4	398.00	16.75	23.26	15.50	1.75	7.00	0.75	1.25	0.25	15.25	1.25	39.00	4.00	5.55
T_5	368.50	15.25	21.18	18.25	2.50	8.50	1.00	1.50	0.25	17.50	1.25	45.75	5.00	6.94
SEm(±)	0.39	053	-	0.33	0.22	0.42	0.12	0.15	0.16	0.36	0.21	1.26	0.42	-
CD 0.05	1.22	1.62	-	1.02	0.69	1.29	0.37	0.47	0.51	1.11	0.64	3.89	1.31	-

Plot size = 7.2 sq. m., , SEm = Standard Error Mean, CD = Critical Difference, PTM Potato Tuber Moth

It was revealed from the present investigation that all the treatment schedules were significantly superior over control in reducing tuber damage by different pests. Out five treatment schedules T_3 and T_2 were most effective treatment schedules by recording highest percentage of healthy tubers (88.21% and 85.78% respectively) and highest tuber yield (25.97 t/ha) and (25.14 t/ha) respectively. It was because of the fact that in case of T_3 phorate and chloropyriphos were applied along with other chemical insecticides and in T_2 chloropyriphos also applied, followed by application of thiamethoxam (25 WG) and it was reported by many workers (Das and Ram, 1998 ; Kishore and Mishra, 2001; Tripathy et al., 2003) that only chloropyriphos or phorate plus chloropyriphos gave better results in reducing the tuber damage caused by cutworm as well as mole cricket. In addition to this Islam *et al.,* (1990) also recorded more than 80% reduction in infection level of cutworm in pyrithroids and chloropyriphos treated plots. Konar et al.(2003) obtained more tuber damage (both number and weight basis) in Bacillus turingiensis var. Kurstaki treated plots than phorate and chloropyriphos treated plots. Next to control (T_1) maximum percentage of damaged tubers were found in T_5 which was consisting of only bio-pesticides. Konar *et al.,* (2005) also observed higher level of infestation of mole cricket in plot, where no chemical insecticides (only bio-pesticides) were applied.

In conclusion two experiments were conducted to study the some important pests on potato germplasms and their integrated management during rabi season from the month of November, 2007 to March, 2008. Eight potato germplasms were screened against different pests viz., cutworm, mole cricket, potato tuber moth and rat under field conditions.

Kufri Surya, Kufri Chipsona-2 and Kufri Pukhraj supported maximum plant damage caused by cutworm and mole cricket. Kufri Anand was found highest healthy tubers of potato and other higher yielded germplasms were Atlantic, Kufri Jyoti and Kufri Surya.

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