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Impact of spot application of insecticide on the different cultivars of Maize against fall army worm (*Spodoptera furgiperda* Smith) under conservation agriculture

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Abstract
An experiment was conducted at Balindi Research Complex Farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal during *Rabi* season of 2018-2019, to evaluate the impact of spot application of Fipronil 5 % SC @ 1 ml per litre of water against the fall army worm in maize crop. Fipronil 5% SC @ 1 ml per litre of water was applied in the maize field as spot application in three different tillage along with different fertilizers regimes of five hybrid maize cultivars (PAC 741, ADV 759, ADV 757, PAC 751, ADV 9293). Among the tillage, zero tillage showed lowest population (0.04) whereas in conventional tillage and reduced tillage the population density of the pest was almost the same. Again, among the fertilizer's residue doses, the treatment with 100% paddy straw residue + 75% N. P. K and 50% paddy straw residue + 75% N. P. K showed significantly reduced pest population (0.02) just 3rd days after spraying. Among the five varieties ADV-757 performs the best across the tillage and fertilizer regimes.

Keywords: Maize, fall armyworm, tillage, cultivar, zero tillage

Introduction
Maize (*Zea mayz* L.) popularly known as "Queen of cereals" occupied the third important position after rice and wheat throughout the world with respect to production and productivity [1]. In India, near about 9.09 Million hectare land is occupied under maize cultivation with the production 24.26 million metric tons and productivity 2.56 metric tons per hectare [20]. In India, Andhra Pradesh (20%), Karnataka (17%), Maharashtra (11%), Bihar (9%), Tamil Nadu (8%), Madhya Pradesh (6%), Rajasthan (6%) and Uttar Pradesh (5%) are reported as the major maize producing states [19]. Among the lepidopteran insect pest profile of maize, fall army worm is the most dangerous one which has the potentiality to cause economic yield loss if the proper management strategy has not been taken [16]. Fall army worm normally passes through four biological stages viz. egg, six larval instars, pupa and adult [15]. The larva is the directly damaging stage of the pest which consumes the vegetative and reproductive plant part. The pest becomes very active causing substantial loss of the crop during night while it remains hidden within the whorl of plant during day. Due to their continuous persistency, damage occurs in the cob and leaves, ears and tassels of the plant and makes the cob unsuitable for consumption [10] [2] [9]. The damage leads up to 70% yield loss [13]. To curb the pest problem, many insecticides having different mode of action has been taken into consideration globally. In the present experiment, it has been emphasized on the spot application of insecticide only on the infested plants observing the initial damage symptoms caused by the pest. The spot application technique has been taken into our major consideration in this experiment with the aim of complete destruction of invading pest population to disrupt the scope of the pest to be the destructive pest population and to minimize the use of the pesticide for the safety of the natural enemies and the ecosystem.

Materials and Methods
Location of Experimental field and season
The research was conducted at Balindi Research Complex Farm (Latitude 22º95´ N and Longitude 88º52´ E, 10 m above mean sea level), Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India during *Rabi* season of 2018-2019.

Field preparation

The entire field was divided into three tillage plots viz. Conventional tillage (CT), Zero tillage (ZT) and Reduced tillage (RT) depending on the tillage intensity. Conventional tillage plots were prepared by giving theprimary tillage with a tractor-drawn disc plough followed by two passes of rigid-tyne cultivator and rotary tiller as secondary tillage to have an excellent tilt and uniform seed-bed. The plots for the reduced tillage were established after sequential tillage operations with two passes of wide Tyne cultivator and two passes of offset disc harrow.

Sowing of crop and fertilizer management

Five cultivar of Maize crop i.e. PAC 741, ADV 759, ADV 757, PAC 751, ADV 9293 were shown on27th November, 2018 with the seed rate 20 kg / ha and spacing 60 cm x 20 cm. The fertilizer dose was given as per recommendation i.e. 160:80:80 NPK kg / ha. Seeding and fertilizer application was done mechanically by multi-crop seed cum fertilizer drill having inclined plate metric mechanism for conventional practiced and reduced tillage practiced and the similar seeding machine attached with inverted 'T'- type furrow opener was used for zero tillage practice for maize cultivation.

Application of Insecticide and impact study

Fipronil (Regent) 5% SC, a phenyl pyrazole group of insecticide was given @ 1 ml / lit. of water as spot application at 30 days after crop sowing by using Knapsack sprayer. Before application, pre-treatment count was taken (Larva / plant) and post treatment count was taken after 1 day after spraying, 3 days after spraying, 7 days after spraying and 10 days after spraying from five different varieties in three tillage plots with five different nutrient-residue combinations. Statistical analysis has been done by using SPSS version 20 by following split-split plot design where tillage in main plots, nutrient-residue combinations in the sub plots and the cultivars were allotted in the sub-sub plots.

Table 1: Field layout of the experiment (Given in a separate landscape sheet)
Experimental treatment details

Name of the crop	Cultivar	Tillage	Nutreint-residue combination
Maize (*Zea mays* L.)	PAC 741	Conventional tillage (CT)	0% paddy straw residue+ 100% N.P.K
	ADV 759		100% paddy straw residue+ 50% N.P.K
	ADV 757		100% paddy straw residue+ 75% N.P.K
	PAC 751		50% paddy straw residue+ 100% N.P.K
	ADV 9293		50% paddy straw residue+ 75% N.P.K
	PAC 741	Zero tillage (ZT)	0% paddy straw residue+ 100% N.P.K
	ADV 759		100% paddy straw residue+ 50% N.P.K
	ADV 757		100% paddy straw residue+ 75% N.P.K
	PAC 751		50% paddy straw residue+ 100% N.P.K
	ADV 9293		50% paddy straw residue+ 75% N.P.K
	PAC 741	Reduced tillage (RT)	0% paddy straw residue+ 100% N.P.K
	ADV 759		100% paddy straw residue+ 50% N.P.K
	ADV 757		100% paddy straw residue+ 75% N.P.K
	PAC 751		50% paddy straw residue+ 100% N.P.K
	ADV 9293		50% paddy straw residue+ 75% N.P.K

Result and Discussions

Effect of Fipronil on *Spodoptera furgiperda* in different tillage treatment

The data on pest population recorded during the experimental period reveals that highest population of fall army worm was noticed in reduced tillage (0.68) followed by conventional tillage (0.64) and zero tillage (0.5) at pre-treatment condition. At 1 day after treatment, maximum mean population was observed in the reduced tillage (0.5) and the lowest population was recorded in the conventional tillage (0.41) (Fig. 1).

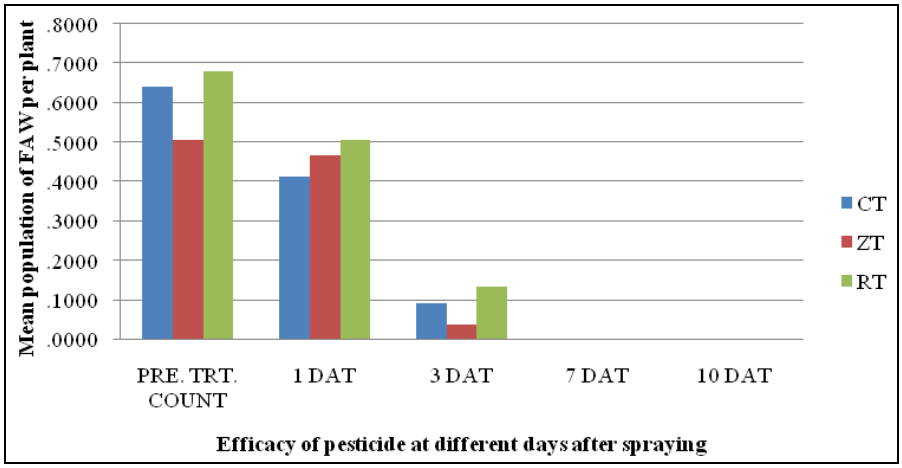


Fig 1: Graphical presentation of mean population of *Spodoptera furgiperda* in different tillage at different days after spraying

The real impact of spot application was noticed 3 days after spraying and onwards. At 3 days after spraying zero tillage resulted the lowest population (0.04) whereas in conventional tillage and reduced tillage the population was very close to each other. Thereafter no pest population was recorded from the experimental plots (Table 2).

Table 2: Mean population of fall army worm at different tillage at different days after spraying

Tillage	Pre. Trt. Count	1 DAT	3 DAT	7 DAT	10 DAT
CT	.6400	.4133	.0933	0.0000	0.0000
ZT	.5067	.4667	.0400	0.0000	0.0000
RT	.6800	.5067	.1333	0.0000	0.0000
MSE	.003	.002	.005	.002	.002
SE(d)	0.01	0.01	0.01		
CD(0.05)	0.02	0.02	NS		
Mean	0.61	0.46	0.09		
CV (%)	9.04	9.71	79.28		

Effect of Fipronil on *Spodoptera furgiperda* in different nutrient-residue combinations

In the present experiment, each tillage plot was subdivided with five different nutrient-residue combinations. During pre-treatment count, maximum pest infestation (0.71) was recorded at 3rd nutrient-residue combination i.e. 100% paddy straw residue + 75% N.P.K which was followed by (0.68) in 2nd nutrient-residue combination (100% paddy straw residue+ 50% N.P.K), 0.62 in 4th nutrient-residue combination (50% paddy straw residue+ 100% N.P.K), 0.53 in 5th nutrient-residue combination (50% paddy straw residue+ 75% N.P.K) and 0.48 in 1st nutrient-residue combination (0% paddy straw residue + 100% N.P.K) (Fig. 2).

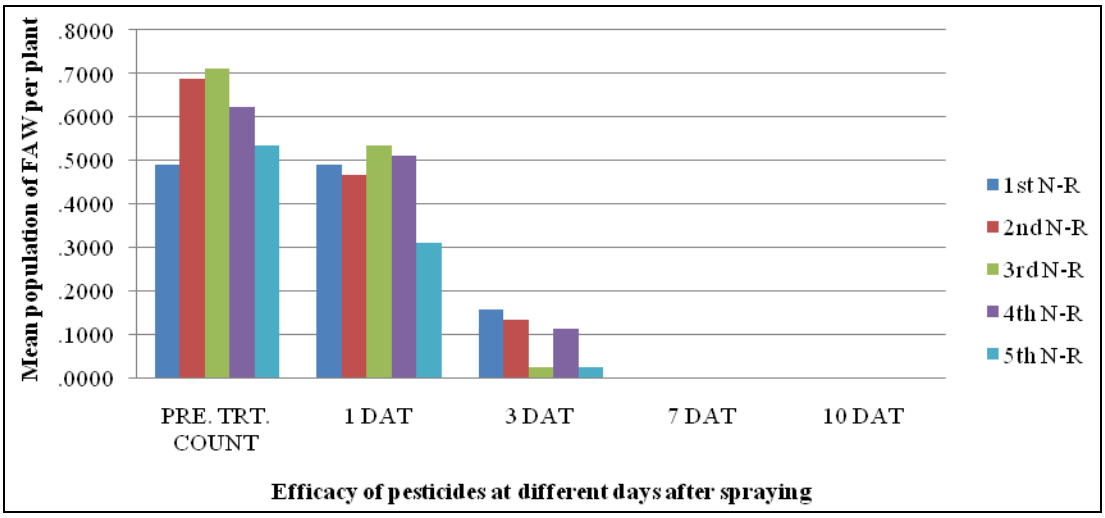


Fig 2: Graphical presentation of mean population of *Spodoptera furgiperda* in different nutrient-residue combinations at different days after spraying

At one day after spray, lowest pest population (0.31) was occurred in 50% paddy straw residue+ 75% N. P. K and highest (0.53) was recorded from 100% paddy straw residue + 75% N.P.Kand 3rd days after spraying there was a significantly reduction in pest population (0.02) in 100% paddy straw residue + 75% N.P.K and 50% paddy straw residue+ 75% N.P.K. At 7th and 10th days after spraying the notorious pest was successfully controlled from the maize field (Table. 3).

Table 3: Mean population of fall army worm at different nutrient-residue combinations at different days after spraying

N-R Combination	Pre. Trt. Count	1 DAT	3 DAT	7 DAT	10 DAT
1st N-R	.4889	.4889	.1556	0.0000	0.0000
2nd N-R	.6889	.4667	.1333	0.0000	0.0000
3rd N-R	.7111	.5333	.0222	0.0000	0.0000
4th N-R	.6222	.5111	.1111	0.0000	0.0000
5th N-R	.5333	.3111	.0222	0.0000	0.0000
MSE	.005	.008	.004	.002	.002
SE(d)	0.014237	0.018446	0.013125		
CD(0.05)	0.03	0.04	0.03		
Mean	0.61	0.46	0.09		
CV(%)	11.09	18.93	70.04		

Effect of Fipronil on *Spodoptera furgiperda* in different maize cultivars

Five different hybrid maize cultivars were taken for this study. From the experimental study it was observed that before insecticide application, cultivar ADV 757 showed superiority by harbouring less insect population (0.37) among all others varieties. At 1st day after spraying, ADV 757 performed best showing very less population (0.13) and rest varieties remaining susceptible to pest attack (Fig. 3).

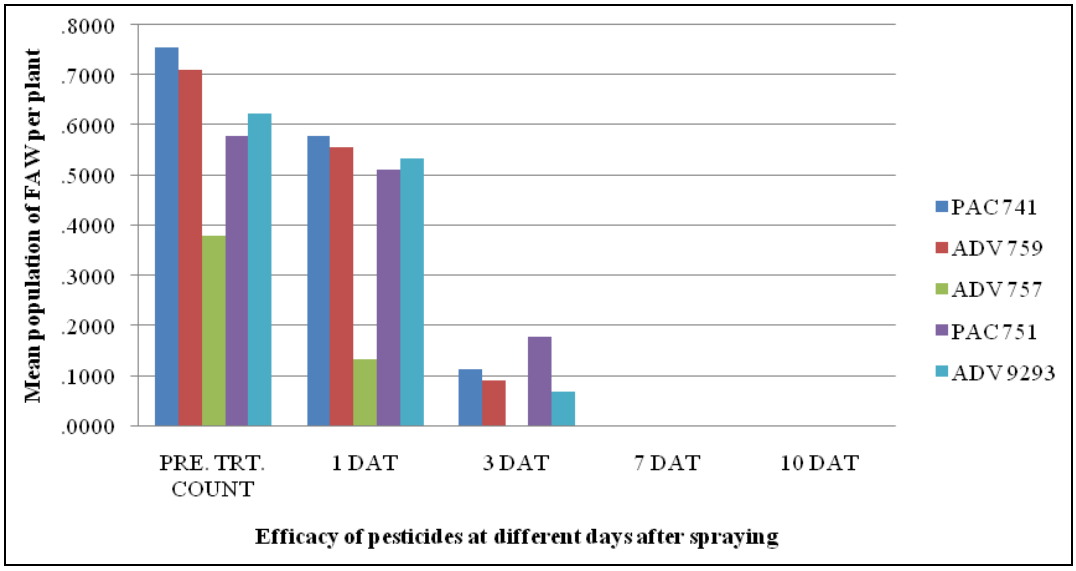


Fig 3: Graphical presentation of mean population of *Spodoptera furgiperda* in different maize cultivars at different days after spraying

Complete wipe out of pest population was occurred from the var. ADV 757 at 3rd days after spraying and spraying at subsequent days was able to eliminate the entire populations from the cultivars (Table. 4).

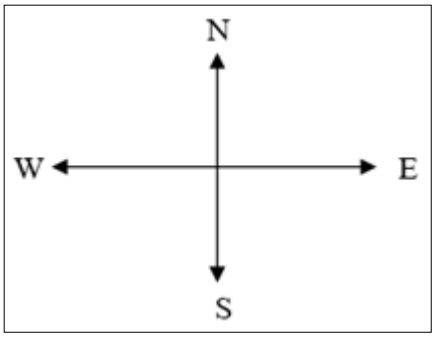
Table 4: Mean population of fall army worm at different cultivars at different days after spraying

Var.	Pre. Trt. Count	1 DAT	3 DAT	7 DAT	10 DAT
PAC 741	.7556	.5778	.1111	0.0000	0.0000
ADV 759	.7111	.5556	.0889	0.0000	0.0000
ADV 757	.3778	.1333	0.0000	0.0000	0.0000
PAC 751	.5778	.5111	.1778	0.0000	0.0000
ADV 9293	.6222	.5333	.0667	0.0000	0.0000
MSE	0.01	0.01	0.01		
SE(d)	0.02	0.02	0.02		
CD(0.05)	0.05	0.04	0.03		
Mean	0.61	0.46	0.09		
CV(%)	17.74	19.56	90.36		

The fall army worm (*Spodoptera furgiperda*) was appeared as a serious yield reducing pest of maize crop since last few years throughout the globe. Sharabasappa *et al.* [17] reported Fall army worm for the first time from Karnataka as invasive pest from maize crop. Throughout the world, entomologists are still fighting for the management of this notorious insect pest. Colborn [6] and Crowe and Booty [7] opined that management can be achieved by the use of different types of synthetic insecticides but according to the findings of Blanco [3] and Hurska and Gould [13], the pest in now appearing as difficult to manage due to lacking of proper knowledge in the time of application, method of application, using of suitable insecticides. Farmers are using Actamiprid, Lamda cyhalothrin, Emamectin benzoate, Cypermethrin as the control measures against the fall army worm but Kuate *et al.* [14] opined that among the tested chemicals Cypermethrin was used profusely due to its promising knock down effect. Considering the other findings, highest larval mortality more than 90% in field condition was obtained by Spinosad by Cruz *et al.* [8]. Similarly like field experiment, some laboratory study was done to show the insecticidal impact on the mortality of fall army worm. Hardke *et al.* [11] recommended that new generation insecticides like Chlorantraniliprole, Flubendiamide, and Spinetoram showed the best result than widely used insecticides like Lamda cyhalothrin, Novaluron in laboratory environment. Burtet *et al.* [4] conducted the experiment to study the efficacy of different kinds of insecticidal mixture on the fall army worm and they suggested that mixture of Spinetoram @ 12 g a.i/ ha, Methomyl + Chlorantraniliprole @ 322.5 + 25.60 g a.i/ha, Lamda-cyhalothrin + Lufenuron @ 25 + 157.5 g a.i/ha and Chlorantraniliprole @ 15 g a.i/ha were recorded as the best management options for curbing the fall army worm problem in maize crop. Hardke *et al.* [12] confirmed that application of Chlorantraniliprole @ 0.1 kg a.i/ha and Novaluron @ 0.1 kg a.i/ha was best effective against fall army worm. Considering the perusal of available of literatures, the present study was focussed on the use of spot application of Fipronil in maize crop to avoid the primary invading pest population from the field. From our experimental result it has been shown that, spot application technique has successfully suppressed the entire fall army population from the field, though Camilo *et al.* [5] reported that in laboratory condition Fipronil was not effective as field condition. Triboni *et al.* [5] showed that seed treatment by mixture of Fipronil + Pyraclostrobin + Thiophanate methyl @ 200 ml per 100 kg of soybean seed showed 60% efficacy in fall army worm management in soybean crop. So far, various experiments had been carried out emphasizing on the management aspect of fall army worm by using different insecticides having diverse mode of action. In the present experiment we have tried to manage this notorious pest in a different way with the aim of suppression of the pest problem, minimize the toxicity of insecticides on natural enemies and to reduce the chance of toxic deposition of pesticides in soil and environment.

Table 5: Field Layout of the experimental design at Balindi Research Complex Farm of Bidhan Chandra Krishi Viswavidyalaya

Conventional tillage					Zero tillage					Reduced tillage				
1st N-R Comb.	2nd N-R Comb.	3rd N-R Comb.	4th N-R Comb.	5th N-R Comb.	1st N-R Comb.	2nd N-R Comb.	3rd N-R Comb.	4th N-R Comb.	5th N-R Comb.	1st N-R Comb.	2nd N-R Comb.	3rd N-R Comb.	4th N-R Comb.	5th N-R Comb.
PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741	PAC 741
ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759	ADV 759
ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757	ADV 757
PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751	PAC 751
ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293	ADV 9293



Conclusion

The experiment was conducted to evaluate the impact of spot application of Fipronil @ 1 ml per litre of water against the fall army worm in maize crop. It has been found that spot application showed excellent result in suppressing the pest population in all the maize cultivars. It can be concluded from the present experiment that implication of spot application against the fall army worm will be better option for its management considering the long term aspect.

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References

1. Ansari MA, Jat SL. Maize production technology highlighted in North East India. Training manual, published by Tribal sub plan, ICAR, IIMR, Lamphelpat, Imphal, 2015, 1-54.
2. Abrahams P, Bateman M, Beale T, Clottey V, Cock M, Colmenarez Y *et al*. Fall Armyworm: Impacts and Implications for Africa; Evidence Note (2); CABI: Oxfordshire, UK, September, 2017.
3. Blanco CA. Maize pests in Mexico and challenges for the adoption of integrated pest management programs. Journal of Integrated pest management. 2014; 5(4):1-9.
4. Burtet LM, Bernardi O, Melo AA, Pes MP, Strahl TT, Guedes VC *et al*. Managing fall armyworm, *Spodopterafurgiperda* (Lepidoptera: Noctuidae) with Bt maize and insecticides in southern brazil. Pest management science, 2017. doi: 10.1002/ps. 4660
5. Camillo MF, Di Oliveira JRG, de Bueno AF, Bueno RCODF *et al*. Seeds treatment on maize for *Spodopterafrugiperda* control. Ecossistema. 2005, 30(1/2):59-63.
6. Colborn T. Pesticides-How research has succeeded and failure to translate science into policy: Endocrinological effects on wildlife. Environmental Health Perspectives. 1995; 103:81.
7. Crowe A, Booty WG. A multi-level assessment methodology for determining the potential for groundwater contamination by pesticides. Environmental monitoring and assessment. 1995; 35(3):239-261.
8. Cruz I, Figueiredo MDLC, Silva RBD, Silva IFD, Paula CD, Foster JE *et al*. Using sex pheromone traps in the decision making process for pesticide application against fall army worm (*Spodopterafurgiperda*) (Lepidoptera: Noctuidae) larva in maize. International Journal of Pest management. 2012; 58(1):83-90.
9. Capinera JL. Fall Armyworm, *Spodopterafrugiperda* (J. E. Smith) (Insecta: Lepidoptera: Noctuidae), 2017. Available online: http://edis.ifas.ufl.edu/in255 (accessed on 10 October 2017).
10. De Almeida Sarmento R, de Souza Aguiar RW, Vieira SMJ, de Oliveira HG, Holtz AM *et al*. Biology review, occurrence and control of *Spodopterafurgiperda* (Lepidoptera: Noctuidae) in corn in Brazil. Bioscience Journal. 2002; 18:41-48.
11. Hardke JT, Jackson RE, Leonard BR. Opportunities to manage fall armyworm (Lepidoptera: Noctuidae) on Bollgard II cotton with reduced rates of insecticides. Journal of Cotton Science. 2014; 18:59-67.
12. Hardke JT, Temple JH, Leonard BR, Jackson RE *et al*. Laboratory toxicity and field efficacy of selected Insecticides against fall armyworm (Lepidoptera: Noctuidae). Florida Entomologist. 2011; 94(2):272-278.
13. Hruska AJ, Gould F. Fall armyworm (Lepidoptera: Noctuidae) and *Diatraealineolata* (Lepidoptera: Pyralidae): Impact of larval population level and temporal occurrence on maize yield in Nicaragua. Journal of Economic Entomology. 1997; 90(2):611-622.
14. Kuate AF, Hanna R, Abang AF, Nanga SN, Ngatat S, Tindo M *et al*. *Spodoptera furgiperda*Smith (Lepidoptera: Noctuidae) in Cameron: Case study on its distribution, damage, pesticide use, genetic differentiation and host plants. PLOSOne. 2019; 14(4):1-

18.
15. Luginbill P. The fall armyworm. USDA Tech. Bull. No, 1928, 34.
16. Prasanna BM, Huesing JE, Eddy R, Peschke VM. Fall Armyworm in Africa: A Guide for Integrated Pest Management, 1st ed.; CIMMYT: Edo Mex, Mexico, 2018.
17. Sharabasappa, Kalleshwaraswamy CM, Asokan R, Mahadevaswamy HM, Maruthi MS, Pavithra HB *et al*. First report of the fall armyworm, *Spodoptera furgiperda* (J E Smith) (Lepidoptera: Noctuidae), an alien invasive pest of maize in India. Pest management in Horticultural Ecosystem. 2018; 24(1):23-29.
18. Triboni YB, Luciano DB Jr., Raetano CG, Negrisoli MM *et al*. Effect of seed treatment with insecticides on the control of *Spodoptera furgiperda* (J.E. Smith) (Lepidoptera: Noctuidae) in soybean. Arquivos do Instituto Biologico. 2019; 86:1-6.
19. Yadav OP, Prasanna BM, Yadava P, Jat SL, Kumar D, Dhillon BS *et al*. Doubling Maize (*Zea mays* L.) production of India by 2025 challenges and opportunities. Indian Journal of Agricultural Sciences. 2016; 86(4):427-434.
20. Yadav OP, Hossain F, Karjagi CG, Zaidi PH, Chawla JS, Kaul J *et al*. Genetic improvement of maize in India retrospects and prospects. Agricultural Research. 2015; 4:325-338.