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Indigenous technical knowledge (ITK) based pest management practices for Boro paddy in Northern parts of West Bengal

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Abstract
Boro paddy is an important crop in Northern districts of West Bengal, but the crop have to pass through various biotic and abiotic stresses among which insect pest is one of the most important limiting factors. For protecting the crops farmers usually rely upon chemical pesticides that gradually hamper non-target organisms, increase cost of production etc. Among the non-pesticidal alternate technologies, indigenous technology may play pivotal role in bringing sustainability in agriculture. A number of indigenous knowledge based pest management module for *boro* paddy have been formulated and tested in the agro-ecosystem under consideration during *boro* season of 2015 and 2016. Inspiring results obtained in field trial from two years of study. Insect pest population observed lowest in chemical based pest management module but natural enemy complex found drastically low. Hence, considering the ill effects of pesticidal application in agro- ecosystem and increasing cost of production, the indigenous technical knowledge based pest management technology may be accommodated as one of the most viable as well as effective tools of IPM in *boro* paddy.

Keywords: Indigenous technical knowledge, *boro* paddy, IPM, pest, module

Introduction
Paddy is the predominant crop of West Bengal and is grown in three different season based on harvesting time *i.e Aus* (autumn rice), *Aman* (winter rice) and *Boro* (summer rice). Among them, *Boro* paddy has a major contribution to the percentage share of total paddy production in the state. It is cultivated during November-December to May-June. The crop passes through various biotic and abiotic stresses. Among the biotic factors insect pests are one of the most important limiting factors followed by diseases and weeds. During the cultivation of *boro* rice in northern belt of West Bengal farmers are usually give their best effort to produce good yield. But the crop have to pass through various biotic and a biotic stresses. The rice plant is subject to attack by more than 100 species of insects; but the crop loss is caused by the some of major insects pest such as Yellow Stem Borer (YSB). It infests the crop during Vegetative stage causing Dead Heart (DH) and during reproductive stage causing White Ear Head (WEH).Gall Midge attack is seen during vegetative stage compaction and crinkling of upper leaves called as Silver shoot or onion shoots. Gundhi bug is also serious pest which infest mainly in reproductive stage for sucking milky sap of rice grains, Moreover Leaf folder is also gaining importance as major pest in northern West Bengal (Pathak and Khan 1994) [1].
However, these biotic stresses on crops are nothing new. From time immemorial, when man started agriculture at the beginning of the civilization pests were there, may be in low intensity. In the age of modern civilization the art of agriculture has been changed. It has now been modernized with latest state-of-the-art agro-technology. The technology touches every nook and corner of agriculture from crop cultivar to crop protection and even up to post harvest. The agro-ecologies are being modified, cropping intensity increased several fold. With a view to protect the crops including rice from insect pest menace presently the farming community using toxic hazardous chemical insecticides indiscriminately. This phenomenon not only destabilizing agro-ecosystem but also creating problems like resistance, resurgence, secondary pest outbreak etc in addition to health hazards of the users as well as increasing cost of cultivation. Thus, the agriculture has now become chemicalised and trapped in agro-chemicals. To get rid of these ill effects on the environment and agro-ecosystem, the age-old indigenous technical knowledge (ITK) may take pivotal role in lowering down the toxic chemical load on

the agricultural produce, stabilisation of agro-ecosystem as well as lessening cost of cultivation leading to remunerative crop cultivation. From time immemorial when there were no such chemicals were in use the farmers used to protect their crop through such indigenous techniques which they have obtained from their ancestors. In every ethnic group of people all over the world these are the in-built knowledge base found in every sphere of life including agriculture. The northern parts of West Bengal are not exception in this aspect, rather in this region a large number of aboriginal populations are there engaged in agriculture from time immemorial. Hence, there remains every possibility of prevailing handful of such indigenous technical knowledge (ITK) in the farming communities. A good number of them have also been documented and analysed as well as refined by Laskar (2015a) [2]. These technologies are of low cost, easily available and above all eco-friendly. Insect pests (yellow stem borer, leaf folder, gall midge, gundhi bug etc.) infestation is also playing good role in realising optimum yield potentiality of the crop. Successful inclusion of these ITKs in present day IPM strategy of *boro* paddy may change the crop production scenario in the agro-ecological region under consideration including lowering down the cost of production and increasing net return.

Keeping in view the aforementioned perspectives the present studies have been undertaken to evaluate the effectiveness of various ITK based crop protection module for *boro* paddy.

Materials and Methods

The field experiments were conducted at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India during two consecutive boro seasons of 2015 and 2016. The variety taken for the study was 'Anjali', a high yielding variety cultivated both during kharif as well as boro season.

Materials used in indigenous technology are

a. Fish tail palm, *Caryota urens* L.
b. Bishkatali, *Polygonum hydropiper* L.
c. Used bi-cycle tyre
d. Snail flesh, *Pila sp* Shankh.
e. Lamda cyhalothrin 5.0 EC (Trade name: Karate, Mfg. by Indofil Industries Ltd.)
f. Fipronil 0.3 G (Trade name: Regent, Mfg. by Bayar India Ltd.)
g. Fipronil 5SC (Trade name: Regent, Mfg. by Bayar India Ltd.)
h. Control.

The crop, boro paddy was transplanted during second week of February every year. First top dressing was given after 21 days of transplanting @ 4 kg Urea per bigha. The plot size was 5X6mt with five replications. Recording of observation was started from one week after first top dressing. All other agronomic practices for raising the crop were as per recommendation of boro paddy in terai region of West Bengal. Statistical design followed was Randomised Block Design (RBD).

Different treatment of ITK

Fig 1: Application of *Poligonum* sp. in irrigation Channel

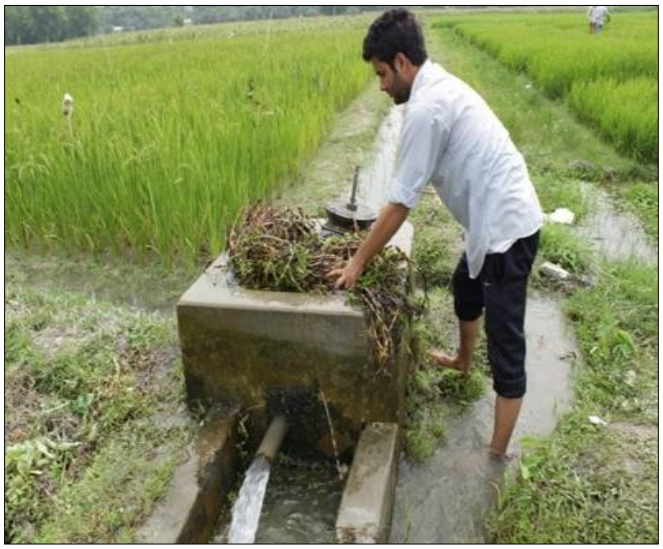

Fig 2: Dipping of *Poligonum sp* In irrigation source

Fig 3: Burning of used bi-cycle tyre in evening

Fig 4: Erection of fish tail palm leaves on *boro* field

Implementation of prepared snail flesh pouch in ITK field and its efficacy

Erection of pouch consisting of snail flesh

Fig 5: Toxicated with Lemda cyahalothrin.

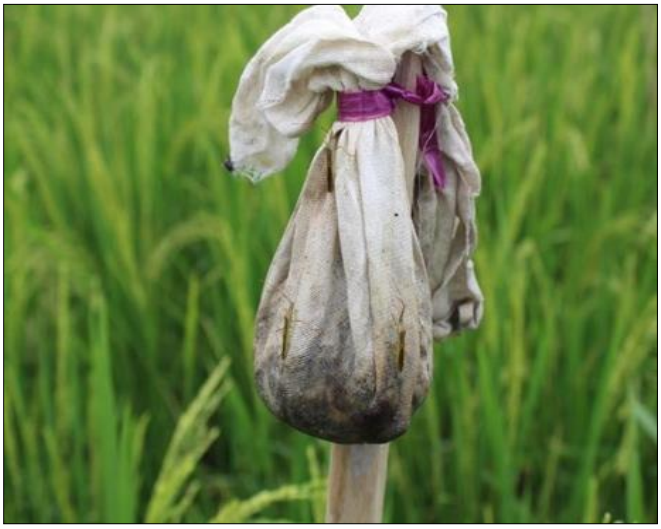

Fig 6: Trapping of Gundhi bug

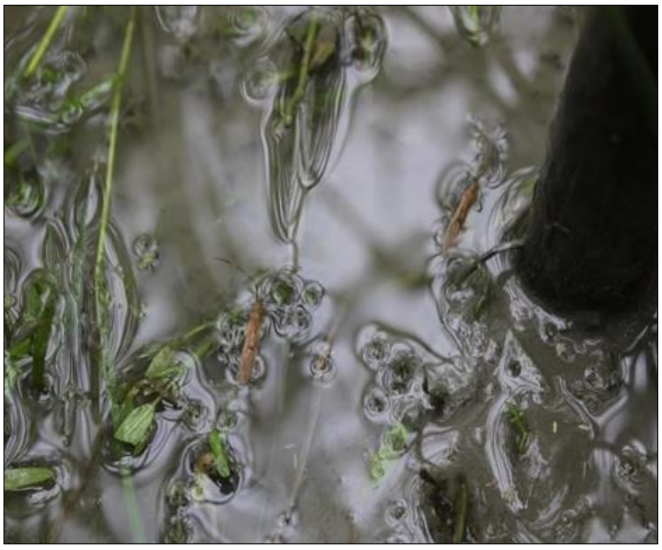

Fig 7: Falling of dead Gundhi bug atthebase.

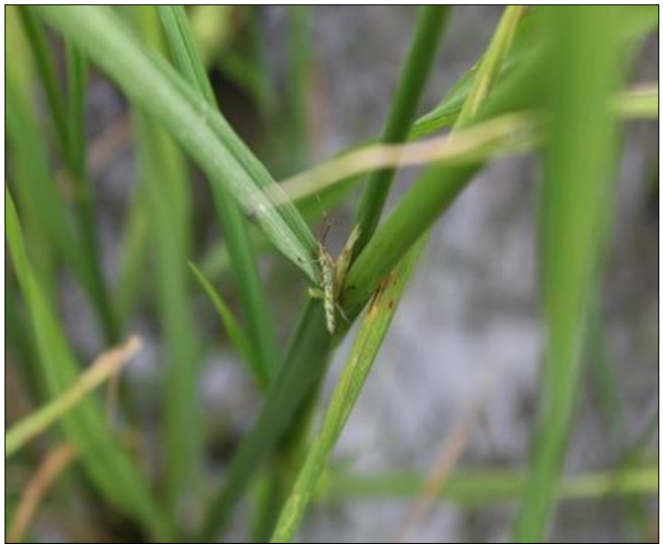

Fig 10: Falling of intoxicated Gundhi bug in leaves.

Preparation of snail flesh in laboratory

Fig 11: Aquatic Snail (*Pilasp*).

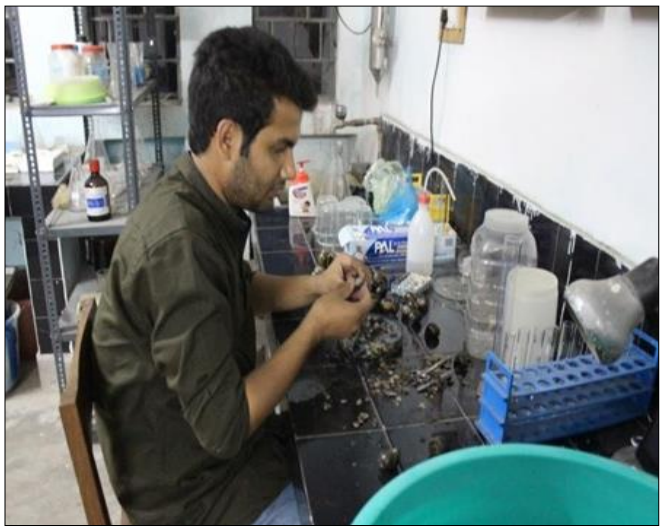

Fig 12: Removal of snail flesh from the shell

Fig 13: Close- up view of pull out Procedure of snail flesh.

Fig 14: Smashing of snail flesh

Statistical analysis

Data thus obtained were stabilised and statistically analysed by Microsoft Excel and INDOSTAT (a statistical software) presented in tabular as well as graphical form. Inference were drawn as per Gomez and Gomez (1984) [3].

Results and Discussion

Paddy is infested by a number of insect pest under terai agro-ecological system of West Bengal. Among them, considerable number of pests caused damage to crop as observed from pooled over data of insect pests population and their degree of infestation in both chemical, ITK based module as well as control plot.

Yellow stem borer, *Scirpophaga incertulus* (Walker) (Pyrallidae: Lepidoptera)

Formation of dead heart due to yellow stem borer, *Scirpophaga incertulus* (Walker) (Pyrallidae: Lepidoptera) was observed within the range from 0.28 to 1.21 (DH/m^2). Maximum infestations of pest have been observed in control plot (1.21 DH/m^2). Lowest infestation have been observed in chemical based pest management module (M4) (0.28 DH/m2). Among the ITK based pest management module M1, M3 are seem to be statistically at par (0.64 and 0.61 DH/m^2 respectively). During reproductive stage of the crop infestation of white ear head (WEH) was recorded lowest (0.20 WEH/m^2) in chemical based management module as compared to that of control plot (1.38 WEH/m^2).

Rice gall midge, *Orseolia oryzae* Wood Mason (Cecidomyiidae: Diptera)

Degree of infestation of gall midge have been observed within the range of (0.02 to 0.72 onion leaf /m^2). Among the pest management modules, infestation on control plot was observed maximum (0.72 onion leaf /m^2) whereas it was observed negligible (0.02 onion leaf/m^2) in chemically controlled plot. Among the ITK based module M1 (0.18 onion leaf/m^2) and M2 (0.19 onion leaf/m^2) appeared as statistically at par efficiency and M3 (0.15 onion leaf/m^2)

Rice leaf folder, *Cnaphalocrocis medinalis* (Guenee) (Pyralidae: Lepidoptera)

Leaf folder infestation observed during field experiment of (pooled over 2015 and 2016) ranged from 0.13 to 0.82 (folded leaf/m^2) being maximum in control plot (0.82 folded leaf/m2) and minimum in chemical based module (0.13 folded leaf/m^2). Moderate infestation observed in ITK based management module. However, M1, M2, M3 revealed statistically at par impact i.e. no variation have been obtained among the ITK based management module.

Rice grasshopper, *Hieroglyphus* sp. (Acrididae: Orthoptera)

The absolute population of grasshopper in the experimental plot ranges from (0.69 to 1.73/m^2) where minimum population was observed in chemical based management module and maximum population was observed in control plot (1.73/m^2). With regard to the ITK based modules all showed their efficacy but M1 significantly reduced grasshopper population.

Rice whorl maggot, *Hydrellia philippina* Ferino (Ephydridae: Diptera)

Infestation of Whorl Maggot have been observed lowest (0.72 infested leaf/m^2) in case of chemical based module whereas maximum (2.17 infested leaf/m^2) in case of control plot. However, the module M1 (1.52 infested leaf/m^2), M2 (1.67 infested leaf/m^2) and M3 (1.69 infested leaf/m^2) reflected similar efficacy with regard to whorl maggot.

Gundhi Bug, *Leptocorisa acuta* (Thunb.) (Coreidae: Hemiptera)

It is a reproductive stage pest and causes damage to the crop after panicle emergence. Chemical based module effectively suppressed this pest (0.18/m^2). ITK based management module i.e. M1, M2, M3 also considerably showed their efficacy (1.37, 1.19, 1.27/m^2) as against control (1.98/m^2). Implementation of all the indigenous techniques in M4 help reducing gundhi bug infestation significantly among the ITK based management module.

Table 1: Insect pest intensity in different ITK based pest management module of boro paddy (pooled over 2015-16)

Module	Yellow stem borer		Gall midge (Onion leaf)(No./m^2)	Leaf folder (Folded leaf/m^2)	Grasshopper (No./m^2)	Whorl maggot (Infested leaf/m^2)	Gundhi bug (No./m^2 Dead heart)
	Dead heart (No./m^2)	White ear head (No./m^2)					
M1	0.64 (0.80)	0.46 (0.68)	0.18 (0.42)	0.23 (0.48)	1.17 (1.08)	1.52 (1.23)	1.37 (1.17)
M2	0.66 (0.81)	0.43 (0.66)	0.19 (0.44)	0.32 (0.57)	1.30 (1.14)	1.67 (1.29)	1.19 (1.09)
M3	0.61 (0.78)	0.31 (0.56)	0.15 (0.39)	0.25 (0.50)	1.38 (1.17)	1.69 (1.30)	1.27 (1.13)
M4	0.52 (0.72)	0.38 (0.62)	0.09 (0.30)	0.26 (0.51)	1.29 (1.14)	1.29 (1.34)	1.05 (1.02)
MC	0.28 (0.53)	0.20 (0.45)	0.02 (0.14)	0.13 (0.36)	0.69 (0.83)	0.72 (0.85)	0.18 (0.42)
Control	1.21 (1.10)	1.38 (1.17)	0.72 (0.85)	0.82 (0.91)	1.73 (1.32)	2.17 (1.47)	1.94 (1.39)
SEM (±)	0.0219	0.0129	0.0081	0.0017	0.0902	0.0018	0.0128
CD at 0.05%	0.0976	0.1190	0.0451	0.1087	0.1465	0.1672	0.2671

* Figures within parenthesis indicate square root transformed values. MC= Chemical based module.

[M1= Application of *Polygonum* leaves in irrigation channel at vegetative stage, M2= M1+ Erection of fish tail palm branches in field at vegetative stage), M3=M2+Burning of used bi-cycle tyre during vegetative and reproductive stage at weekly intervalat fortnightly interval, M4= M3+ Attracticide with snail flesh and lamda cyhalothrin after panicle emergence, M5= Recommended chemical management (Fipronil 0.3G after first top dressing, application of Lamda cyhalothrin at vegetative stage and one application of Fipronil 5SC after panicle emergence), C= Control (Spraying with water only)].

Earlier, several workers have investigated the impact of indigenous technical knowledge in suppressing the pests of rice in different rice growing corners of the country (Anonymous, 1999) [4] and (Irangini and Shiratake, 2013) [5]. Keeping slices of pomelo, *Citrus grandis* Osbeck in paddy field @ 1 trap/6 sq. metre repels stem borer population as reported by Pathak *et al*. (2001) [6]. Essential oils in pomelo have been found to repel the stem borer population after placing grounded bark of drumstick (*Moringa oleifera* Lam.) in rice field. Bark of drumstick may contain some insecticidal principles in addition to its medicinal properties (Vaidyaratnam, 1995) [7]. Laskar (2015 b) [8] reported that freshly recovered snail flesh are effective in attracting gundhi bug during reproductive stage of rice in field condition.

Conclusion

The indigenous technologies are low cost, easily available and have no deleterious effects on agro-ecosystem. The technologies are practiced by the farming communities of northern West Bengal. It is also an established fact that the indigenous knowledge varies from region to region and community to community. The technologies are still in practice among the farming communities of northern West Bengal. However, these are not so effective as latest synthetic chemical insecticides. But obviously they have good effect in suppressing pest population in *boro* paddy. So, considering the cost effectiveness, availability and eco-friendly nature the technologies these may be included in the present day integrated pest management (IPM) programme particularly for the farming communities of northern West Bengal. Because the materials that are used in these technology are available here and are also socially accepted. Hence, the indigenous technical knowledges may not be the only option but may be accommodated as one of the most viable as well as effective tools of IPM of *boro* paddy under northern parts of West Bengal.

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