Final report

Title: Workshop for sharing experience on recycling of rice plant residues for enriching lands with organic matters and in-time cultivation of next crop

1. Rationale

Each year, around 50 million tones of rice straw are produced in Viet Nam, but most of it was burnt in the fields or along the roads. This not only wastes a valuable carbon source, but also causes air pollution and generates greenhouse gas (CO_2). During past years, NOMAFSI has developed techniques for "quick composting" of rice plant residues in the field right after the harvest using an efficient microorganism product (EM) of NOMAFSI which has been approved by MARD for commercial use.

This "quick composting" technique is simple enough for farmers to apply at small and large scale plots: After harvesting of rice, spray the EM product directly over the plant residues in the field; and when the plant residues have been decayed cultivate the next rice crop as normally. With straw after threshing: make small piles of straws in a suitable places in the field, spray the EM over the straws and, when the straws have been degraded use them as organic fertilizers for rice or for other crops.

Results obtained in some demonstration sites in Phu Tho and Yen Bai provinces showed that only 7-10 days after treatment with this EM product the field could be ready for the next crop cultivation, and rice plants expressed better growth with stronger root system and gave higher yield. This proposal is to share experience of the application of this technical innovation towards its large-scale adoption in paddy production in the Northern mountainous region of Vietnam.

2. Objectives

The main objective is to introduce and encourage use of EM product to recycle rice straw for increasing rice production and reducing greenhouse gas emission.

3. Activities

- Literature review
- On-farm experimentation
- Workshop organization

4. Methods

Activity 1:

- Desk-review was the method that was used to collect information about EM products that were produced and introduced in Viet Nam.

Activity 2:

- Selected sites: Linkage to national program to select sites for implanting on farm experiments. Selected sites cultivated two crops per year.

- On-farm experiments were conducted in Yen Bai, Lao Cai, Son La, Dien Bien, Phu Tho province with rice varieties: Huong Chiem, Sheng Cu, BC15, BT7 and Khang dan, respectively. In each location, experiments were carried out with 1.000 m^2. Experiment sites were divided in two parts. One was sprayed with EM product and other was not as control.

Other management practices were applied the same in experiment and control sites.

Parameter observation: Number of panicle, number of filled grain and grain yield

5. Results

5.1. Results of literature review

Agriculture residue is big problem that Viet Nam farmers are facing with. Agriculture residues were not treated by suitable methods not only wasted, also caused environment pollution. In the recent years, researchers and scientists have researched and produced EM products to support farmers to convert agriculture residues to organic fertilizer.

5.1.1. FITO – BIOMIX – RR product

5.1. 1.1.General information

FITO – BIOMIX – RR is EM product that was produced by Ha Noi biotechnology stock company. This product includes:

+ Bacillus polyfermenticus :$\geq 10^8$CFU/g

+ Strepfomyces thermocoprohilus :≥ 10^8CFU/g
+ Trichoderma virens : ≥ 10^8CFU/g
+ Soybean powder, bran…

This product provides EM species that quickly decompose organic matters. And farmers could buy this product through internet channel or extension channel.

5.1.1.2. Results of application of FITO – BIOMIX – RR product

Dang Anh Bang (2013) pointed that 7-10 days after spraying *FITO – BIOMIX – RR*nutrient content in tho soil had significant changed: acidehumic increased 48-68%. Microoganism concentration also significant developed from 10^3-10^4 CFU/g before spraying EM to 10^5-10^6 CFU/g.

After that *FITO – BIOMIX – RR product*was applied in some provinces:

*** In Bắc Ninh province**

In 2013, ***FITO – BIOMIX – RR product***was introduced to recycle rice straw in NgangNoi village. Evaluation of farmers who applied this product showed that: only 25 days after using rice straw completely decomposited, of which rice straw without EM required 6-8 months to decompose.

- In 2014, this product was introduced to apply in ThuậnThành, Tiên Du, Yên Phong, Gia Bìnhdistricts. Up to end of 2014, there was 500 tons ofrice straw which were recycled by this EM.

- This EM was also used to recylcle other agriculture residues. And given good results.

*** In ThápiBìnhprovince**

In 2012, Fito - Biomix RR was introduced in Thanh Tân, KienXuong with participation of 100 farmers. In 2013, this product was adopted in Dong Hung district with participation 450 farmers. Besides, using directly in the field, Fito - Biomix RR was used to recycle rice straw in the heap. And potato and vegetables grew well by applying rice straw compost.

*** InBắc Giang province**

Im 2012, Fito - Biomix RR was introduced by Bac Giang DARD to recycle rice straw in Bac Giang province: 3.000 tons of rice straw were decomposed with using this procduct. Rice straw compost had good quality and crops grew well as applying this compost. Bac Gang DARD showed fields sprayed this product improved on fertily.

5.1.2. Biomix 1

5.1.2.1 Oringin of Biomix 1

Biomix 1 product was developed and produced by Bio-technology institute with

+ Bacillus polyfermenticus :≥10^8CFU/ml
+ Strepfomyces thermocoprohilus :≥ 10^8CFU/ml
+ Trichoderma virens : ≥ 10^8CFU/ml
+ Water, additives

Farmers could buy this product through extension channels.

5.1.2.2 Results of application

Using probiotics rice straw decomposition was faster than without use. Namely, rice straw was disposed by Biomix have decomposing time about 50 days After the end of experiment, soil $N_{available}$content of rice straw was buried with Biomix treatment was high (23,70 mg/kg); soil $P_{available}$content of rice straw was buried with Biomix treatment wasn't statistical significant (19,64 mg/kg – 20,45 mg/kg). Soil C/N ratio of rice straw was buried with Biomix treatments was low (from 14,63 to 15,52). It's lower than rice straw was buried

without Biomixtreatment (18,57) and burned rice sraw (19,61) (Nguyen Xuan Du, et al. 2010).

Other results:

- **Treating of domestic waste:** Biomix 1 was used to treat domestic waste in Ha Noi, Viet Tri, Thai Binh. The results showed that by adding Biomix 1, decomposed time decreased from 45 days to 30 days as compare to add air. So, using Biomix 1 to treat domestic waste would save energy.

- Treating of agricultural residues

*** InVĩnhPhúc**

In 2007, Biomix 1 was introduced to recycle agriculture residues in districts of Vinh Phuc. Biomix 1 had helped to solve pollution for agricultural residues. Agriculture residues compost was applied to produce safe vegetables as Chayote crop..

In 2012, Center of Advanced technology application provided 30 ton of Biomix1 to Vinh Yen, Tam Duong, Vinh Tuong, BinhXuyen, Phuc Yen, Tam Dao, Yen Lac, Lap Thach.

5.1.3. Trichoderma

5.1.3.1 Origin of Trichoderma

Trichoderma was developed by Cuu Long rice research institute in 2012 with ingredient: Trichoderma. This product is sold in the shops.

5.1.3.2. Results of application of Trichoderma

The results of Tran Thi Ngoc Son et al. (2010) presented that, 4 weeks after applying *Trichoderma* nutrition content (total Nitrogen, phosphorus, potassium) of soil significant increased: 49%; 42,8% and 23,3% respectively in comparison with control as applied in An Giang province and 17,9%; 36,2% and 17,1% respectively in Can Tho province

Besides that: By using Trichoderma to recycle rice straw save input (about 1.8 million VND per ha) for chemical fertilizer, grain yield still increased 0,33 ton per ha and net income increased 4.3 million VND per ha in An Giang and save input (about 1.7 million VND per ha) for chemical fertilizer, grain yield still increased 0,4 ton per ha and net income increased 4.2 million VND per ha in Can Tho

5.1.4. Sumitri

5.1.4.1 Origin

Sumitri (Super Humic Trichoderma PADCO) was developed by Phuong Nam agriculture development limited company (PADCO).

Ingredient of Sumitri: Trichoderma spp 1x109 CFU (Trichoderma hazzinaum T22, Trichoderma viide, Trichoderma pacerramosum, Trichoderma spp); Acid Humic 25%; Acid Fulvic 10%; Mg, S, Zn, Cu, Ca…and additives.

Farmers could buy this product through internet and extension channels

***5.1.4.3** Results of application of Sumitri product*

*** In HảiPhòng**

In 2014, Hai Phong DARD introduced and applied Sumitri product to recycle rice straw for 300 ha of rice in districts. Results showed that 7 days after spraying mostly rice straw in the field was decomposed. Rice plants grew well, grain yield was 10-15% higher than field without using EM. In additionally, input cost for fertilizer decreased 10%.

*** InTháiNguyên**

In 2016, Sumitri was introduced to spray in 5 ha of rice in Thai Nguyen city with 30 farmers involved and results presented Summitri supported to quickly decompose rice straw in the field.

5.1.5. EMIC

5.1.5.1. Origin of EMIC

Emic is product of Compay of Micro-organisim and environment technology.

EMIC includes: *Bacillus, Lactobacillus, Streptomyces, Sacharomyces,....*

Farmers could buy this product through internet or extension channels.

5.1.5.2Results of application

Le Xuan Giang (2016) pointed that, by using Emic, rice straw compost had lower OC concentration than that of control without Emic and increased nutrition content (N, P, K). Namely, OC% was 9,89 to 10%; N% was 1,6-1,7%; P_2O_5% was 1,7%; K_2O was 1,3%.

Other results:

*** InLâmĐồng**

In Lam Dong, Emic was used to decompose coffee residue. Coffee residue compost was applied coffee crop. By using coffee compost, farmers decreased 50% input cost. In additionally, coffee crops resist well to diseases.

*** InNghệ An**

In 2010, Emic was used to produce organic fertilizer in Anh Son district. Materials to produce organic fertilizer were agriculture residues: maize stem, rice straw, peanut,...and particularly, sugarcan leaves, because this is big sugarcane area. Materials after wetting will be treated with Emic to produce organic fertilizer. Organic fertilizer is applied to sugarcane.

*** InHảiPhòng**

In 2013, Application of Emic to recycle agriculture residues project was implemented in ThủyNguyên district.

5.1.6.Hatimic

5.1.6.1 Origin of product

This is product of Company of Micro-organisim and environment technology. This product includes: *Bacillus subtilis; Bacillus lichenfomic; Lactobacillus sp; Saccharomyces cerevisiea.*

This product is sold through internet shops and extension channels.

5.1.6.3 Result of application

*** In HàTĩnh**

Organic fertilizer was decomposed by Hatimic was applying to rice, peanut and vegetable cultivation. The results showed that by using organic fertilizer (adding Hatimic) decreased 15-20 percent of chemical fertilizer and crop yield increased 5-10 percent..

5.1.7. BioVAC

5.1.7.1 Origin

BiOVAC includes 6 micro-organisms: phosphorus decompostied micro-organisms; potassium decompostied micro-organisms; cellulose decompostied micro-organisms; nitrogen fixed micro-organisms; IAA synthesis micro-organisms; Acidlactic generated micro-organisms.

This product is sold through Viet Nam gardening association.

5.1.7.2 Results of application

*** In Thanh Hóa**

In 2013, BioVAC was introduced to recycle agriculture residues in Dong Son district. By applying BioVAC, farmers could save money for input cost and decreased environment pollution. Applying compost adding BioVAC improved soil fertility.

5.1.8.Emuniv

5.1.8.1 Origin

EMUNIV includes: *Bacillus subtilis và Bacillus licheniformis, Lactobacillus plantarum, Lactobacillus acidophilus, Streptomyces sp, Saccharomyces cerevisiae, Bacillus megaterium.*

Farmers could buy this product through internet shop.

5.1.8.2 Results of application

*** InTháiBình**

In 2009, Emuniv was introduced to treat rice straw and rice straw added Emuniv was quickly decomposed and avoided environment pollution.

*** InPhúThọ**

In 2012, Emuniv was provided to treat rice straw in Lam Thao and Tam Nong district. By using Emuniv, rice straw was quickly decomposed and bad smell was also deodoranted.

5.1.9.Vixura

5.1.9.1 Origin

Vixura is product of Viet Nam biotechnology institute with cellulose decomposited micro-organisms.

And this product is sold through extension channels.

5.1.9.2 Results of application

*** InBắc Ninh**

In 2007, Vixura was introduced to recycle rice straw in Gia Binh district. The results presented application organic fertilizer (added Vixura) improved soil structure. Rice ecosystem also improved.

In additionally, by application of Vixura to treat rice straw had solved air pollution by burnt and discharged rice straw to environment.

*** In high land area**

In 2013, Vixura was instroduced to recycle agricultural residues: rice straw, coffee husk, tea and pepper residues... *The results showed agriculture residues were quickly decomposed by adding Vixura*.

*** InThừa Thiên Huế**

In 2016, Vixura was use to treat Common water hyacinth. By using this product to recycle common water hyacinth, local authorities had save budget to clean this crop.

5.1.10. EM – FERT 1

This product was developed and produced by Sao Mai technical company. It includes micro-organism that could digest cellulose, lignin, hemicelluloses.

EM FERT-1 includes micro-organism that could digest cellulose, lignin in rice straw into Nitrogen, Potassium phosphorus available.

EM FERT-1 could be used to deordorant, treated sewage and domestic waste and change them into organic fertilizer.

This product was certificated by ministry of science and technology in 2017 and is sold through internet shop to treat animal dung.

Name of the product	Composition	Producing company / agency	Price	Marketing channels (how farmers can access it)	Provinces / Villages where it has been tested	Number of farmers or area involved in testing
FITO – BIOMIX – RR	*Bacillus polyfermenticus; Strepfomyces thermocoprohilus;Trichoderma virens;* Soybean powder, bran	Ha Noi biotechnology stock company	40.000 VND/200 gram	Internet shops and extension channels	Bac Ninh, Thai Binh, Bac Giang	450 in Thai Binh
BIOMIX 1	*Bacillus polyfermenticus; Strepfomyces thermocoprohilus; Trichoderma virens*; Water, additives.	Biotechnology institute	60.000 VND/lit	Extension channels	Vinh Phuc	30 ton of Biomix were distributed to farmers
TRICHODERMA	Tricoderma	Cuu Long rice research institute	80.000VND/1 kg	Available in shops	An Giang, Can Tho	10 ha of rice were sprayed by EM
SUMITRI	*Trichoderma hazzinaum T22*, *Trichoderma viide*, *Trichoderma pacerramosum*, *Trichoderma spp*; Acid Humic; Acid Fulvic; Mg, S, Zn, Cu, Ca…and additives	Phuong Nam agriculture development limited company	30.000 VND/125 gram	Internet shop and extension channel	Hai Phong, Thai Nguyen	30 farmers in Thai Nguyên, 300 ha In Hai Phong
EMIC	*Bacillus, Lactobacillus,*	Compay of Micro-	20.000	Internet	Lam Dong,	50 farmers

	Streptomyces, Sacharomyces	organisim and environment technology	VND/200 gram	shop and extension channel	Nghe An, Hai Phong	
HATIMIC	*Bacillus subtilis; Bacillus lichenfomic; Lactobacillus sp; Saccharomyces cerevisiea*	Company of Micro-organisim and environment technology	30.000 VND/200 gram	Internet shop and extension channel	Ha Tinh	6 ton of EM were distributed
BIOVAC	Phosphorus decompostied micro-organisms; potassium decompostied micro-organisms; cellulose decompostied micro-organisms; nitrogen fixed micro-organisms; IAA synthesis micro-organisms; Acidlactic generated micro-organisms.	Center of rural community development	75.000 VND/1 kg	Viet Nam Gardening association	Thanh Hoa	21
EMUNIV	*Bacillus subtilis và Bacillus licheniformis, Lactobacillus plantarum, Lactobacillus acidophilus, Streptomyces sp, Saccharomyces cerevisiae, Bacillus megaterium*	Applied microbiology joint stock company	30.000 VND/200 gram	Internet shops	Thai Binh, Phu Tho	
VIXURA	Cellulose decomposited micro-organisms	Viet Nam biotechnology institute	65.000 VND/kg	Internet shop	Bac Ninh, Thue Thien Hue	30 ha in Bac Ninh
EM-FERT 1	Micro-organisms that could digest	Sao Mai technical	60.000	Internet	-	

	cellulose, lignin, hemicelluloses	company	VND/kg	shop		

5.2. Results of On-farm experimentation

In 2017, AT decomposite was trialed in Yen Bai, Lao Cai, Son La, Dien Bien, Phu Tho provinces. The results present that:

- Number of panicle per square meter was 3.96 – 7.5 percent higher than that of control (Figure 1)

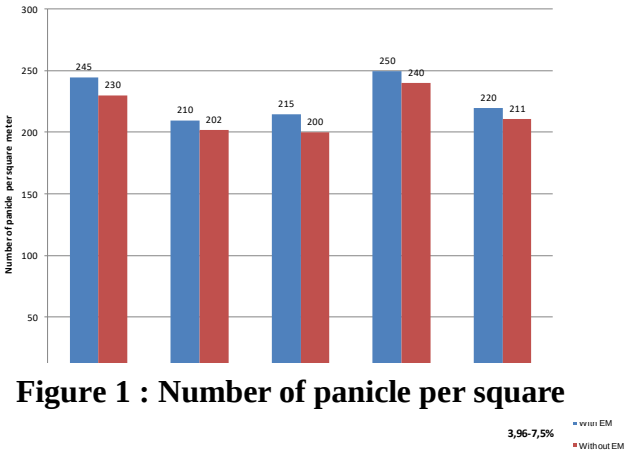

Figure 1 : Number of panicle per square

- Number of filled grain per panicle was from 3.6-11.1 percent higher than that of control (figure 2).

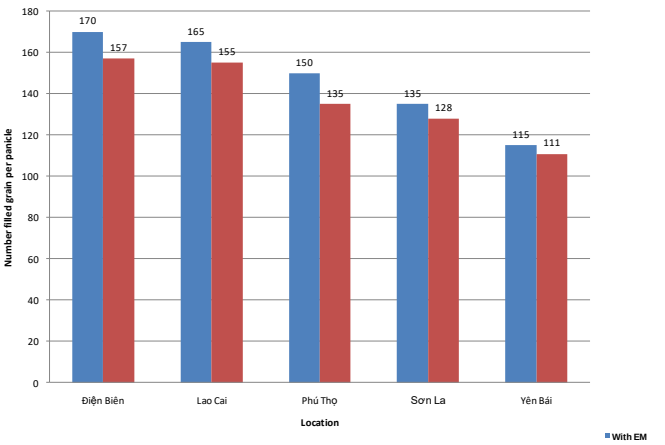

Figure 2 : Number of filled grain per panicle

- And grain yield was 3.38 – 5.76 percent higher than that of fields without applying EM product (figure 3).

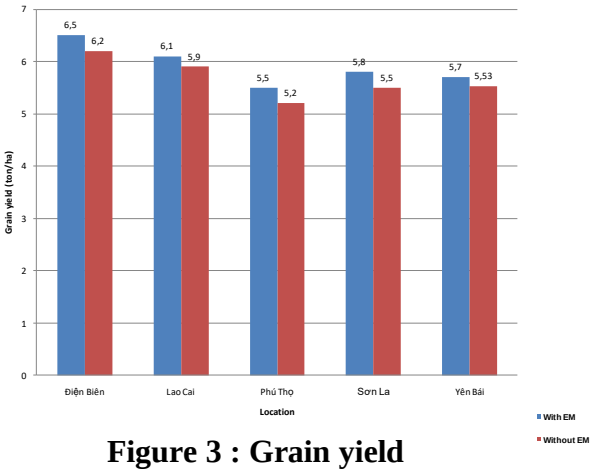

Figure 3 : Grain yield

Pests/diseases incidence

Related to pests/diseases incidence, observation results showed that there was not different between plot with EM spraying and control in all experiment sites on pest incidence. But there was different on disease incidence between plot with EM spraying and control in locations (below table). These maybe by spraying EM not only quickly decomposed rice straw, also killed diseases born.

Location	Plot	Stem borer (point)	Leaf folder (point)	Brown hopper (point)	Leaf blast (point)	Sheath blight (point)	Bacterial blight (point)
Lào Cai	EM	1	1	1	1	1	1
	Ctrl	1	1	1	3	5	3
Yên Bái	EM	1	1	1	1	1	-
	Ctrl	1	1	1	3	5	-
Phu Tho	EM	1	1	1	1	1	1
	Ctrl	1	1	1	3	1	5
Điện Biện	EM	1	1	3	1	1	1
	Ctrl	1	2	3	3	3	3
Sơn La	EM	1	1	1	3	1	1
	Ctrl	1	1	1	3	3	3

Benefit

In all experiment sites, although farmers need investing EM product but they could reduced input cost for pesticides/fungicides, so all the fields with EM spraying gave higher on net income than that of Control (below table).

Loction	Plot	**Input cost (1.000 VND)**	*Seed*	*Fertilizer*	*Pesticides/ fungicides*	*EM product*	**Grain yield (ton/ha)**	**Gross income (1.000 VND)**	**Net income (1.000 VND)**
Điện Biên	EM	9.660	1.800	6150	900	810	6,5	58.500	48.840
	Ctrl	9.150	1.800	6150	1.200		6,2	55.800	46.650
Lao Cai	EM	9.160	1.800	5550	1.000	810	6,1	91.500	82.340
	Ctrl	8.950	1.800	5550	1.600		5,9	88.500	79.550
Phú Thọ	EM	9.160	1.800	5750	800	810	5,5	38.500	29.340
	Ctrl	9.050	1.800	5750	1.500		5,2	36.400	27.350
Sơn La	EM	9.660	1.800	6150	900	810	5,8	46.400	36.740
	Ctrl	9.350	1.800	6150	1.400		5,5	44.000	34.650
Yên Bai	EM	9.720	1.800	6360	750	810	5,7	45.600	35.880
	Ctrl	9.510	1.800	6360	1.350		5,5	44.000	34.490

5.3. Results of workshop organization

Opening remarks by Tran Duc Lam, Deputy Director of Yen Bai Agriculture and Rural department:

Yen Bai is one of the 15 provinces in the northern mountainous region of Vietnam (NMR). The province is lying between the Northwest and Northeast region of Vietnam, bordering Ha Giang and Tuyen Quang in the east, Son La in the west, Phu Tho in south and Lao Cai province in the north. There are 1 town, 1 city and 7 districts in Yen Bai.

The total area of Yen Bai is 688,628 km^2 (ca. 2% of the country's total area), of which ca. 585,000 ha (85%) are for agriculture and agro-forestry production. ***Yen Bai province's topography is highly complicated*** which is elevated from the Southeast to the Northwest of the province. The Hoang Lien Son mountain range in the West is located in between the Red and Da rivers; then the Elephant mountain range is located in between the Chay and Lo rivers in the East of the province. These mountain systems divide the province into two regions according to elevation: the highland and lowland regions. The highland region has the average altitude of more than 600 m asl. and occupies 67.56% of the province' territory. This region, though with low population density, has high potential for economical development (rich in land, forest, minerals and genetic resources). The lowland region has the average elevation of lower than 600 m asl., including mainly low mountains and hills, inter-located with valleys. This region occupies 32.44 % of the province' territory and is more developed than the other region.

According to the topography and the main climate features, Yen Bai can be divided into 2 main regions:

- West region: average elevation is above 700m asl. In high locations the climate is temperate, with very low temperature (below 0^oC) during the cold season, and with less rains, suitable for sub-tropical and temperate crops. Due to the complexity and diversity in topography in this West region there are different micro-climate zones.
- East region: with lower average elevation, with higher average temperatures and more rains. There are plains with good conditions for intensive agriculture. There are also big water surface area (Thac Ba lake), appropriate for aquaculture.

Yen Bai has the total natural area of almost 688,628 ha which are currently used as below: Over 474,121 ha (69% of the total area of the province), mostly steep and high slopes, are used for forestry production; 109,320 ha (15.8%), mainly flat and not too steeply sloping lands, for production of annual and perennial crops and animals; 1,586 ha (0.2%) of water surface for aquaculture and fishery; 54,000 ha (8%) for other purpose: roads, schools, factories...; 50,000 ha (7%) are not yet used. Most (over 45,000 ha) of this unused land area in high mountains. Among the unused lands, 1,358 ha are with potentials for.

In the past 10 years, Yen Bai received NOMAFSI's support. On behalf of the Yen Bai authorities thank to efforts of NOMAFSI researchers.

Nowadays, agriculture production in Yen Bai is facing with challenges, particularly on recycling residues. In the recent years, there are some EM products introduced to decompose residues, but it is difficult to scale out.

We are really delighted to have scientists and leaders and participants (farmers, extension officers) from VAAS and 13 provinces belong to Northern of Viet Nam to participate in this important meeting.

This meeting is aiming to discuss the way to scale out application of EM products to recycle agriculture residues.

We have the opportunity to discuss and sharing information to achieve its objectives towards promoting the adoption of EM product application Vietnam northern. Thank you all for your research and development inputs on rice, and for your time for this meeting. I wish you all a successful meeting and good health.

Presentations:

Results of research and produce AT products, Mr Trinh Quoc Binh, NOMAFSI

Mr Binh reported that agriculture production generates about 10-12 ton of residue per ha and 80% of this residue is burned and charge to environment. To recycle this resource, we have research and produce EM product to quickly decompose agriculture residues.
This EM product includes 11 effective micro-organisms and has two types: liquid and powder.
He also presented it took only 25-30 day to rice straw completely decomposed by this EM product and rice straw compose has high nutrient value: organic matter content (26,8%); total nitrogen (2,41%); nitrogen fixation micro-organism content: 4,8 x 10^6 CFU/g; phosphorus digestion microbial content: 7,4 x 10^6 CFU/g; enemial microbial content in root sytem: 6,5 x 10^6 CFU/g (support to crops resist to diseases).

Results of application of AT product on recycling agriculture residues, Dr Nguyen Duc Thanh, NOMAFSI

Dr Thanh showed that farmers saved labor and cost for chemical fertilizer by applying AT product to recycle rice straw directly in the field. Besides, by application of AT product on decomposing rice straw decreases air pollution due to stopping rice straw burn or charge to environment.
From his presentation pointed there were about 2.000 ha of rice using AT product to quickly decompose rice straw in the field in Vinh Phuc, Thai Binh, Nam Dinh, Phu Tho, Ha Giang… in only 2015.

Results of application of AT product on recycling rice straw in Ma village in 2016, Mr Le Khai Hoan, NOMAFSI

Ma village was selected to build climate smart village (CSV) by CCAFs program. So, in 2016, NOMAFSI introduced AT product to quickly recycle rice straw in the field. By doing this, rice root system was stronger, and increased number of panicle, number of filled grain and grain yield: 37,1%; 24,5% and 16,8% respectively.
He also presented more than 100 farmers in Vinh Kien commune who were trained using AT product on recycling rice straw.

Discussion

Ms Nguyen Thi Thu, a farmer who using this product opinioned: application of AT product on recycling rice straw gave some benefit:
- Rice straw was collected and village road was cleaner
- Rice straw burning was stopped
- Using rice straw compost increased crop yield and decreased diseases.
- Provided organic fertilizer to cassava, rice, maize, vegetables…

Mr Tam, head of Ma village: Using EM product to recycle rice straw helped to limit applying herbicide to kill rice straw in Ma village. In the past, most of farmers used herbicide to kill rice straw and clear their fields, herbicides poisoned to people and animal working in the field and using water. His suggestion: opening shop Vinh Kien commune to sell this product.

Mr Giang, head of Lam Thao agriculture sector, Phu Tho: In Lam Thao district, AT product was introduced from 2013. When using this product on recycling rice straw gave benefit to farmers: increased grain yield; rice straw compost using to apply to maize, cassava, vegetables. By using rice straw compost increased crop yield and quality and also increased disease resistance of crops. Mr Giang

also showed some challenges on dissemination of this product in large scale: Lack of labor, nowadays lot of farmers move to industrial zone due to rice production gave low income; Depending on land preparing machine, after spraying AT product on the rice straw, land needs to plough immediately to accelerate active of micro-organism but in reality, farmers have to wait for machine. So, it decreased efficiency of this product; Season force, in the recent time, free time from spring to summer season is only 4-5 days, not enough time to completely decomposed rice straw. So, efficiency of this product was not clear. From above problem, he suggested the product should be improved for more conveniently using: produce AT into granule type, give quick efficiency.

Mr Cuong, from Lao Cai DARD: In Lao Cai province, as season force and high rainfall level, summer rice is affected by toxic of rice straw decomposed process in the field. So, he thinks this product will help farmers in Lao Cai solve this problem. Besides, organic fertilizer for agriculture production in Lao Cai is very shortage in the recent years, using this EM product for produce organic fertilizer will useful to produce organic cultivation. And he raised some troubles: Could this product be used for submergence land and acidity land; Could this product be applied to recycle maize and rice husk residues. Representative of ATQ company (under NOMAFSI) has sent explanation for his concerns.

Dr Nguyen The Yen, Viet Nam academy of agriculture science: season force and lack of labor are big problem that Viet Nam agriculture production is facing with. So, researchers and scientists are required more active to innovate and improve technology to meet requirement of reality. He also pointed that Conservation and Organic agriculture is sustainable way for agriculture development in Northern mountainous regions, Viet Nam. And adoption of EM product to recycle agriculture residues will help protected environment and decreased input cost, improved soil structure. He also suggested: Farmers need to link each others to produce in large scale and apply EM product to recycle agriculture residues toward sustainable and safe agriculture production.

Closing remarks by Dr Luu Ngoc Quyen, Deputy Director of NOMAFSI
Dr Quyen thanked all participants for contributions, recommendations and suggestions to the discussion. We saw clearly role of EM product on agriculture production but adoption of EM product in large scale is facing with some challenges: lack of labor; farmers produce at small scale. He suggested, all actors need jointing to adoption of EM product on recycle agriculture residues.

Some pictures


Participants visited experiment site

Participants discussed in the meeting hall