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Comparative Efficacy and Economic Viability of *Trichoderma* Strains as Bio-Control Agents for the Control of *Phytophthora* Pod Rot of Cocoa in Nigeria *(Pp. 349-366)*

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Abstract

The comparative efficacy and economic viability of Trichoderma species as bio-control agents against Phytophthora megakarya which has been hitherto elusive was determined by field application/evaluation, bean yield and accruable revenue evaluation. The trials followed randomized complete block design (RCBD) with 3 field constituting blocks, 24 treatments with 3 trees per treatment per replicate. The treatments were three fungicides, five bio-agents, fifteen combinations of fungicides and bio- agents while the control consists of unsprayed trees. Data were collected on total pod *produced (TP), total number of disease pods (DP) and total number of fermentable pods per tree per treatment (FP) while revenue accrued (RA) and revenue-cost-ratio were also determined accordingly. All the bio-agents significantly reduced the percentage pod-rot on the field. The highest mean pod-rot incidence (16.91) among the treated was significantly lower than the control (30.14). This was observed on BA (NIG-T287) sprayed plots. Funguran 0H + NIG-T289 produced the highest (757) number of pods while the least pod production (312) was observed with Copper Sulphate + NIG-T289 (F3BC) treated plots. The highest revenue-cost-ratio (69.45) was obtained from Copper Sulphate treated plots, while the least revenue-cost-ratio (2.85) was obtained from Ridomil Gold + NIG-T288 treated plots. NIG-T293 performed better than other bio-agents and most of other treatments when applied sole resulting to 45.90 comparative efficacy and economic viability. These bio-agents were successfully combined with fungicides thereby reducing the frequency of fungicide application from four to one with significant pod-rot reduction on the field, comparatively high yield and more profit (high revenue-cost-ratio).*

Keywords: Bio-control agents, comparative efficacy, economic viability, revenue-cost-ratio.

Introduction

Trichoderma species have been known for many years as potential biological control agents against many plant diseases (Adedeji, 2008). The success of *Trichoderma* strains as biological control agents is due to their high reproductive capacity, ability to survive under very unfavorable conditions, efficiency in the utilization of nutrients, capacity to modify the rhizosphere, strong aggressiveness against phytopthogenic fungi, efficiency in promoting plant growth and defense mechanisms as well as ability to withstand some fungicides (Kerr, 1982; Campbell, 1989; Cook and Baker, 1983 and Adedeji, 2008).

In Nigeria, Adedeji et *al* (2005, 2007 and 2008) have demonstrated the efficiency of *Trichoderma* strains as effective bio-control agents against *Phytophthora* pod-rot of Cocoa. However, the comparative efficacy and economic viability has not been determined. The study is therefore carried out to compare the efficacy of these bio-agents along with some commonly used fungicides in the control of *Phytophthora* pod -rot of cocoa in Nigeria as well as their economic viability due to their ability to improve cocoa production.

Materials and Methods

Field Evaluation of Comparative Efficacy of *Trichoderma* Strains and Fungicides against *P. Megakarya*

The field trials were carried out at Ibadan (Cocoa Research Institute of Nigeria, experimental plots) in 2007/2008 cropping season. The experiment was designed to compare the efficacy of the bio-control agents with four recommended and regularly used fungicides. The trials followed randomized complete block design (RCBD), with 3 fields constituting blocks. There were 24 treatments in all with 3 trees per treatment per replicate. The treatments were three fungicides, five bio-agents, fifteen combinations of fungicides and bio-control agents while the control consists of unsprayed trees. One untreated row of cocoa trees separated treatments and at least four border rows surrounded the plots. The plots mainly planted to F_3 - Amazon Cocoa with spacing of 3.1x 3.1 m. The trees were between 30 and 40 years old. Before the commencement of the trials, weeding was done manually; trees were lightly pruned with the removal of secondary and vertical shoots, as well as diseased and damaged pods.

Three fungicides that were tolerated by bio-control agents *in vitro* (Ridomil Gold, Copper Sulphate and Funguran OH) were screened along and in combination with five bio-agents. Recommended rates as stated in Table 1 were used. The bio-agents (*Trichoderma* strains) were mass-produced using a two-step liquid/solid state fermentation according to Hebbar *et al* (2000) using cassava flakes as the solid matrix. Incubation was done at 25 ± 2^0C in ambient light at daytime. Spraying of the plots was done at 21 days interval, while data of infected pods, total green pods and fermentable pods were taken a day before each spraying. The data collected was subjected to analysis of variance (ANOVA) while the means were separated using Duncan's Multiple Range Test (DMRT) using SAS software.

Description and Codes of Some Parameters Used

BA = NIG-T287

BB = NIG-T288

BC = NIG-T289

BD = NIG-T290

BE = NIG-T293

F1 = Ridomil Gold

F2 = Funguran OH

F3 = Copper sulphate

F1BA = Ridomil Gold + NIG-T287

F1BB = Ridomil Gold + NIG-T288

F1BC = Ridomil Gold + NIG-T289

F1BD = Ridomil Gold + NIG-T290

F1BE = Ridomil Gold + NIG-T293

F2BA = Funguran OH + NIG-T287

F2BB = Funguran OH + NIG-T288

F2BC = Funguran OH + NIG-T289

F2BD = Funguran OH + NIG-T290

F2BE = Funguran OH + NIG-T293

F3BA = Copper Sulphate +NIG-T287

F3BB = Copper Sulphate +NIG-T288

F3BC = Copper Sulphate +NIG-T289

F3BD = Copper Sulphate +NIG-T290

F3BE = Copper Sulphate + NIG-T293

Control = unsprayed stands

TP is mean number of pods produced per tree per treatment

DP is mean number of diseased pods per tree per treatment

CY i.e. Cocoa yield is calculated using this formula:-

$$CY = \frac{PP \text{ X } FP}{PI}$$

where: PP is plant population

FP is mean number of fermentable pods per tree per treatment per hectare (1,040 trees);

PI i.e. pod index is the mean number of pods required to produce 1kg of dried bean (40 pods);

Revenue-Cost-Ratio (RCR) is revenue accrued divided by cost calculated by the formula:-

$$RCR = RA\ (CI)^{-1}$$

where: (CI) is Cost of material (₦) + Cost of labour for application of inputs (₦),

Revenue gained (RG) is value (dry) beans per ton (₦)

Yield difference (YD) is yield of treated plot - yield of control plot

Data Analyses

All data collected were subjected to analysis of variance (ANOVA) while the means were separated with Duncan's Multiple Range Test (DMRT) using SAS software. Also regression model and descriptive statistics were used to analyse the data.

Result

Comparative Efficacy of Bio-control and Selected Fungicides for the control of *Phytophthora* pod-rot

Tables 1 and 2 show the effects of BCAs and fungicides singly and in combination in reducing pod-rot incidence on the field as well as improving pod production.-

Pod-rot development as affected by bio-control agents and fungicides application under field condition.

Table 1 shows the mean pod-rot incidence in the field sprayed with three fungicides (Funguran OH, Ridomil Gold and Copper sulphate), five BCAs (NIG-T287, NIG-T288, NIG-T289, NIG-T290 and NIG-T293) and combinations of bio-control agents and fungicides. All the BCAs significantly ($p < 0.05$) reduced the pod-rot incidence on the field compared to the control. While the mean pod-rot incidence obtained from the control (unsprayed) was 30.14, the highest mean pod-rot incidence among the treated was 16.91. This was observed on BA (NIG-T287) sprayed plots. However, BA performance improved when it was combined with fungicides. As against 16.91 mean pod rot incidence recorded in BA sprayed plots, F1BA (Ridomil Gold + NIG-T287), F2BA (Funguran OH + NIG-T287) and F3BA (Copper

Sulphate + NIG-T287) had 11.09, 8.01 and 10.41 respectively. Though BB (NIG-T288) performed significantly ($p < 0.05$) better (12.35) than the control (30.14), yet its performance was enhanced when combined with fungicides (F1BB = 11.66 and F2BB = 11.31) except when combined with F3 (Copper Sulphate) (F3BB = 16.04). The combination of BC (NIG-T289) with fungicides (F1BC = 10.44, F2BC = 9.50 and F3BC = 8.82) enhanced its performance though they were not significantly different ($p < 0.05$) from one another. The combination of BD (NIG-T290) with fungicides enhanced its performance better than its sole application. F3BD produced mean pod-rot incidence (10.22) lesser than its other combinations (F1BD =13.18 and F2BD = 12.08) as well as its sole application (BD = 12.79). Application of BE sole performed better in reducing pod-rot incidence than any of its combinations with fungicides. While only 9.83 mean pod-rot incidence was recorded in plots treated with BE alone, F1BE, F2BE and F3BE had 14.98, 14.22 and 14.81 respectively.

Application of F1 alone was effective in reducing pod-rot incidence than any of its combination with BCAs. While F1 alone had 7.20, its combination (F1BA, F1BB, F1BC, F1BD and F1BE) had 11.09, 11.66, 10.44, 13.18 and 14.98 respectively.

F2 alone was better than any of its combinations (F2BB, F2BD and F2BE), however the difference was not significant ($p < 0.05$) whereas F2BA (8.01) and F2BC (9.50) were better than F2 (11.65). Only two of F3 combinations (F3BB and F3BE) were less than F3 alone (15.28). Others i.e. F3BA (10.41), F3BC (8.82) and F3BD (10.22) were better than F3 alone however they were not significantly different ($p < 0.05$). Generally, F1 and F2 performed better when applied sole than when BCAs were applied sole except BE which was better than F2 and F3. However, the performance of F3 was less to any of the BCAs except BA.

Green Pods Production as Affected by Bio-Control Agents and Fungicides Applications in Field Trials

Table 2 shows total and mean green pods produced by cocoa stands treated with five BCAs, three fungicides and their different combinations. The results show that the combinations of Funguran OH and BCAs enhanced pod production significantly better than other treatments. Funguran 0H + NIG-T289 produced the highest (757) number of pods. This was closely followed by but not significantly different from Funguran OH + NIG-T290 (F2BD), which had 744 pods. Funguran OH + NIG-T288 (F2BB) produced 676 pods however; this was significantly different from the previous two (Table 2).

The performance of Funguran OH was significantly enhanced when combined with BCAs. All the combinations i.e. F2BA (532); F2BB (676); F2BC (757); F2BD (744) and F2BE (517) respectively produced more pods than the fungicide alone (F2; 501) and significantly more than the control (427). However, only F2BB, F2BC and F2BD are significantly higher than F3.

The least pod production (312) was observed with Copper Sulphate + NIG-T289 (F3BC) treatment that was not significantly different from Ridomil Gold (F1) and Ridomil Gold + NIG-T288 (F1BB) treated plots that produced 360 and 314 pods respectively. The control (unsprayed plot) produced 427 pods which was significantly higher than Ridomil Gold (FI) (360), Ridomil Gold + NIG-T288 (F1BB) (314) and Copper Sulphate + NIG-T289 (F3BC) (312) respectively.

Generally, Copper Sulphate (F3) produced more pods significantly higher than other fungicides when singly applied. However its performances were significantly low when combined with BCAs as none of the combinations produce as much as the sole application (F3BA = 395, F3BB = 450, F3BC = 312, F3BD = 412 and F3BE = 521).

Except for F1BB (314), the combination of Ridomil Gold and BCAs (F1BA = 451, FIBC = 444, FIBD = 630 and F1BE = 494) produced more cocoa pods than when Ridomil alone (F1 = 360) was applied. F1BD (630) was significantly better than any of Ridomil treatments whether singly or in combination with BCAs. It was one of the best six treatments. When applied sole, BE produced more pods (639) than other BCAs. This is followed by BA (525), BD (492) and BB (483) respectively, while BC (407) recorded the least pod production.

Effects of Bio-Control Agents, Fungicides Spray on Cocoa Bean Yield and Its Components

The result in Table 3 shows that F2BC produced the largest mean number (84.11) of pod (TP) per treatment per tree and had the highest effect on bean yield by producing 1,232.4kg/ha above the control. This was closely followed by F2BD which had 82.66 and 1,142.86kg/ha mean number of pod per tree per treatment and treatment effect above the control respectively. The two were not significantly different from one another but significantly different from the control and the rest treatments. BE, F1BD and F2BB were not significantly different from one another with 918.06kg/ha, 823.16kg/ha and 972.92kg/ha yield above the control, they were however significantly different from other treatments.

Effects of Bio-Control Agents and Fungicides Spray on Expected Revenue/Kg of Cocoa

Table 4 shows the effects of the treatments on the revenue accrued as well as the revenue-cost-ratio per kg of cocoa. The highest revenue accrued (₦332, 748.00) was obtained when Funguran OH was combined with NIG-T289. This was closely followed by (₦308, 599.20) by the combination of Funguran OH and NIG-T290, while the least revenue (₦15, 514.00) was obtained when Ridomil Gold was combined with NIG-T288.

The highest revenue-cost-ratio (69.45) was obtained from Copper sulphate treated plots, this was closely followed by (62.20 and 57.68) Funguran OH + NIG-T289 and Funguran OH + NIG-T290 treated plots respectively while Funguran OH + NIG-T288 had 49.10 revenue-cost-ratio. However, the least revenue-cost-ratio (2.85) was obtained from Ridomil Gold + NIG-T288 treated plots. Surprisingly, NIG-T293 performed better than other bio-agents and most of other treatments when applied sole resulting to 45.90 revenue-cost-ratios

Discussion

When the efficacy of the bio-agents and the fungicides were compared on the field, the control (unsprayed plot) recorded significantly high percentage pod-rot compared to all treated plots. This confirmed the claim of Agbeniyi and Adedeji (2003a) that in Nigeria regular pod-rot outbreak is inevitable except effective control is applied. Since the validity of simple agar plate method of screening bio-agent antagonistic activities has been questioned by various workers (Tronsmo and Hjeljord 1998), the antagonistic activity was screened using cocoa pod husk pieces (CPHP). The result also shows that the performance of these bio-agents are not the same, hence the decision to combine them with the fungicide should not be a blanket one. While application of BE singly is recommended, the combination of others with fungicides are recommended. According to Howell (2003), since all the mechanisms and characteristics necessary for optimum biocontrol are not easily found in a singular organism, hybridization of two or more strains or species of *Trichoderma* is sometimes required to combine beneficial characteristics. Hence more works are suggested in hybridizing and combining these organisms for better performance. It is believed that the resulting *Trichoderma* hybrid given the appropriate formulation and delivery system would be more effective in controlling the disease. Development of bio-agents for the control of pod-rot of cocoa is inevitable going by persistent call for alternative to use of chemicals and production of organic cocoa emanated as a result of inability of agrochemicals to fulfill together all of the society expectations of producing high quality yields from crops; zero risk to the applicator; no adverse effect on the environment (water, soil, air and wildlife) and show zero residues in food (Pfalzer, 1993).

While the application of F1 (Ridomil Gold) and F2 (Funguran OH) singly performed generally better than their combinations in reducing pod-rot incidence, their ability in pod production was low, however the reverse was the case for F3 (Copper sulphate). Apart from general difficulties such as lack of interest by international agrochemical companies; breaking into agrochemical complex; incomplete formulation of regulatory guidelines; high cost of registration and lack of fast registration process (Spadaro and Gullino, 2005), as well as ignorance on the part of farmers (Harman, 2000), the development of biological control strategy in Nigeria is facing other problems like lack of adequate facility and financial support to research and development. In order to attract agrochemical companies into production of bio-agents, emphasis must be placed on integration of bio-agents into chemical control for acceptance. This would stop the agrochemical companies' foot-dragging attitude and encourage production of bio-pesticides which they claimed to be a scarcely remunerated niche product.

According to Benítez *et al* (2004) *Trichoderma* strains (as Bio-agents) can exert positive effects on plants with an increase in plant growth (bio-fertilization), and the stimulation of plant-defense mechanisms thereby preventing disease incidence and enhancing crop production. However, while the results of this study clearly demonstrated disease reduction, increase pod production was also partly buttressed. Taking the control (unsprayed plots) as the standard, the results of this study show that though the farmer may obtained some revenue from his unsprayed plots this could in no way compared with what is obtainable when pod-rot control is applied. According to Oduwole (2004), black-pod (pod-rot) is one the three major problems limiting cocoa production in Nigeria. Its control therefore is a major activity on cocoa farm. He then suggested that targeting of the technology should continue to focus on effective control strategy that will enhance higher yield.

Adequate support to development of bio-control and IPM strategy by the government would increase cocoa production and farmer income as well as national income on the crop.

The highest revenue-cost-ratio recorded from Copper sulphate treated plots could be the reason while Nigerian farmers still prefer the fungicide to other more effective recently screened and recommended (Agbeniyi and Adedeji, 2003b) but more expensive ones. This adoption problem could be solved if various governments could adequately finance the development of a safer control strategy in form of bio-control and IPM package as well as subsidizing the final products for the poor Nigerian farmers.

According to Adejumo (2005), integration of chemical fungicides and bio-control agents based on agro ecological zones would help farmers minimize their dependence on chemical control which would result to superior disease suppression thereby minimizing yield loss. The results of this study where integration of bio-agents and fungicides [as an Integrated Pest Management (IPM) strategy] brought about effective control of *Phytophthora* pod-rot, increase in yield as well as increase in revenue accruable to farmers is a novel breakthrough in Nigeria and require adequate support for further improvements.

Table 1: Pod-rot development as affected by bio-control agents and fungicides application in field trial

Treatment	Mean % Pod Rot
*BA	16.91[b]
BB	12.35 [bc]
BC	14.59 [bc]
BD	12.79 [bc]
BE	9.28 [bc]
F1	7.20[c]
F2	11.65 [bc]
F3	15.28 [bc]
F1BA	11.09 [bc]
F1BB	11.66 [bc]
F1BC	10.44 [bc]
F1BD	13.18 [bc]
F1BE	14.98 [bc]
F2BA	8.01[bc]
F2BB	11.31 [bc]
F2BC	9.50 [bc]
F2BD	12.08 [bc]
F2BE	14.22 [bc]
F3BA	10.41 [bc]
F3BB	16.04[bc]
F3BC	8.82 [bc]
F3BD	10.22 [bc]
F3BE	14.81 [bc]
Control	30.14[a]

NB: - Means with the same letter in the same column are not significantly different ($p < 0.05$) using Duncan Multiple Range Test (DMRT).

F1BE = Ridomil Gold + NIG-T293

* BA = NIG-T287 F2BA = Funguran OH + NIG-T287

BB = NIG-T288 F2BB = Funguran OH + NIG-T288

BC = NIG-T289 F2BC = Funguran OH + NIG-T289

BD = NIG-T290 F2BD = Funguran OH + NIG-T290

BE = NIG-T293 F2BE = Funguran OH + NIG-T293

F1 = Ridomil Gold F3BA = Copper Sulphate +NIG-T287

F2 = Funguran OH F3BB = Copper Sulphate +NIG-T288

F3 = Copper sulphate F3BC = Copper Sulphate +NIG-T289

F1BA = Ridomil Gold + NIG-T287

F3BD = Copper Sulphate +NIG-T290

F1BB = Ridomil Gold + NIG-T288

F3BE = Copper Sulphate + NIG-T293

F1BC = Ridomil Gold + NIG-T289 Control = unsprayed stands

F1BD = Ridomil Gold + NIG-T290

Table 2: Pod production as affected by bio-control agents and fungicides application in field trial

Treatment	Total green pod	Mean green pod
*BA	525	44.33^{ab}
BB	483	39.42^{bc}
BC	407	36.75^{bc}
BD	492	41.00^{bc}
BE	639	53.17^{a}
F1	360	32.92^{bc}
F2	501	41.58^{bc}
F3	614	51.17^{a}
F1BA	451	37.83^{bc}
F1BB	314	30.00^{cd}
F1BC	312	26.17^{cd}
F1BD	630	51.67^{a}
F1BE	494	40.08^{bc}
F2BA	532	44.58^{ab}
F2BB	676	55.17^{a}
F2BC	757	62.83^{a}
F2BD	744	62.67^{a}
F2BE	517	43.67^{ab}
F3BA	395	33.83^{bc}
F3BB	450	37.50^{bc}
F3BC	312	26.75^{cd}
F3BD	412	33.92^{bc}
F3BE	521	44.33^{ab}
Control	427	37.83^{bc}

NB: - Means with the same letter in the same column are not significantly different ($p < 0.05$) using

Duncan Multiple Range Test (DMRT).

* BA = NIG-T287

BB = NIG-T288

BC = NIG-T289

F2BA = Funguran OH + NIG-T287

F2BB = Funguran OH + NIG-T288

F2BC = Funguran OH + NIG-T289

BD = NIG-T290

BE = NIG-T293

F1 = Ridomil Gold

F2 = Funguran OH

F3 = Copper sulphate

F1BA = Ridomil Gold + NIG-T287

F1BB = Ridomil Gold + NIG-T288

F1BC = Ridomil Gold + NIG-T289

F1BD = Ridomil Gold + NIG-T290

F1BE = Ridomil Gold + NIG-T293

F2BD = Funguran OH + NIG-T290

F2BE = Funguran OH + NIG-T293

F3BA = Copper Sulphate +NIG-T287

F3BB = Copper Sulphate +NIG-T288

F3BC = Copper Sulphate +NIG-T289

F3BD = Copper Sulphate +NIG-T290

F3BE = Copper Sulphate + NIG-T293

Control = unsprayed stands

Table 3: Pod Yield Parameters as Affected By Bio-Control Agents, Fungicides and Their Combinations

Treatment	*Total Pod*	*Diseased Pod*	*Fermentable Pod*	*Bean Yield /Ha/Kg*	***Treatment Effect/Ha/Kg*
**BA*	58.30	9.89	48.41	1258.66	511.94
BB	53.66	6.62	47.04	1223.04	476.32
BC	45.22	6.81	38.41	998.66	251.94
BD	54.66	7.20	47.46	1233.96	487.24
BE	71.00	6.97	64.03	1664.78	918.06
F1	40.00	2.90	37.10	946.60	217.88
F2	55.66	6.48	49.18	1278.68	531.96
F3	68.22	9.82	58.40	1518.40	771.68
F_1BA	50.11	5.72	44.38	1154.14	407.42
F_1BB	34.88	3.95	30.93	804.18	57.46
F_1BC	49.33	5.23	44.10	1146.60	399.88
F_1BD	70.00	9.62	60.38	1569.88	823.16
F_1BE	54.88	7.96	46.92	1219.92	473.20
F_2BA	59.11	4.73	54.38	1413.88	667.16
F_2BB	75.11	8.97	66.14	1719.64	972.92
F_2BC	84.11	7.99	76.12	1979.12	1232.40
F_2BD	82.66	9.98	72.68	1889.68	1142.96
F_2BE	57.44	8.16	49.28	1281.28	534.56
F_3BA	43.88	4.56	39.32	1022.32	275.60
F_3BB	50.00	8.02	41.98	1091.48	344.76
F_3BC	34.66	2.78	31.88	828.88	82.16
F_3BD	45.77	4.38	41.38	1076.14	329.42
F_3BE	57.88	8.66	49.22	1279.72	533.00
Control	47.44	18.72	28.72	746.72	Nil

** BA = NIG-T287	F2BA = Funguran OH + NIG-T287
BB = NIG-T288	F2BB = Funguran OH + NIG-T288
BC = NIG-T289	F2BC = Funguran OH + NIG-T289
BD = NIG-T290	F2BD = Funguran OH + NIG-T290
BE = NIG-T293	F2BE = Funguran OH + NIG-T293
F1 = Ridomil Gold	F3BA = Copper Sulphate +NIG-T287
F2 = Funguran OH	F3BB = Copper Sulphate +NIG-T288
F3 = Copper sulphate	F3BC = Copper Sulphate +NIG-T289
F1BA = Ridomil Gold + NIG-T287	F3BD = Copper Sulphate +NIG-T290
F1BB = Ridomil Gold + NIG-T288	F3BE = Copper Sulphate + NIG-T293
F1BC = Ridomil Gold + NIG-T289	
F1BD = Ridomil Gold + NIG-T290	
F1BE = Ridomil Gold + NIG-T293	

Control = unsprayed stands

*Treatment Effect = Bean yield of the Treatment – Bean yield of the Control

Table 4: Expected Revenue per Kilogram as affected by Treatment Applications

Treatment	*Cost (Naira)*	*Revenue (Naira/Kg)*	*Revenue-Cost-Ratio*
**BA*	5,400.00	138,223.84	25.60
BB	5,400.00	128,606.40	23.82
BC	5,400.00	68.023.80	12.60
BD	5,400.00	131,554.80	24.36
BE	5,400.00	247,876.20	45.90
F1	5,000.00	58,827.60	11.77
F2	4,400.00	143,629.20	32.64
F3	3,000.00	208,353.60	69.45
F_1BA	5,450.00	110,003.40	20.18
F_1BB	5,450.00	15,514.20	2.85
F_1BC	5,450.00	107,967.60	19.81
F_1BD	5,450.00	222,253.20	40.78
F_1BE	5,450.00	127,764.00	23.44
F_2BA	5,350.00	180,133.20	33.67
F_2BB	5,350.00	262,688.40	49.10
F_2BC	5,350.00	332,748.00	62.20
F_2BD	5,350.00	308,599.20	57.68
F_2BE	5,350.00	144,331.20	26.98
F_3BA	5,300.00	74,412.00	14.04
F_3BB	5,300.00	93,085.20	17.56
F_3BC	5,300.00	22,183.20	4.19
F_3BD	5,300.00	88,943.40	16.78
F_3BE	5,300.00	143,910.00	27.15

**BA = NIG-T287

BB = NIG-T288

BC = NIG-T289

BD = NIG-T290

BE = NIG-T293

F2BA = Funguran OH + NIG-T287

F2BB = Funguran OH + NIG-T288

F2BC = Funguran OH + NIG-T289

F2BD = Funguran OH + NIG-T290

F2BE = Funguran OH + NIG-T293

F1 = Ridomil Gold
F2 = Funguran OH
F3 = Copper sulphate
F1BA = RidomilGold+NIG-T287
F1BB = Ridomil Gold + NIG-T288
F1BC = Ridomil Gold + NIG-T289
F1BD = Ridomil Gold + NIG-T290
F1BE = Ridomil Gold + NIG-T293
F3BA = Copper Sulphate +NIG-T287
F3BB = Copper Sulphate +NIG-T288
F3BC = Copper Sulphate +NIG-T289
F3BD = Copper Sulphate +NIG-T290
F3BE = Copper Sulphate + NIG-T293

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