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In an article in the CABI Int. Journal Prof Gamani S, then of the IFS, and some 14 odd co-authors published an article on their research findings( see Attachment 1) with a poor design (No controls!), very high error values and yields of many crops several fold below what farmers usually achieved! We pointed this out in the Table attached! It is surprising that the editors of the journal dared to publish it! None of them, apparently, even read it! Then recently, another article  (attachment 3) in the Ceylon J. of Science this year, the same group repeated the same serious error of not having appropriate controls. They claim having tested two treatments is some 34 places. What should have been necessary was to to reduce the number of sites and have the two controls Biofilm only and Nil fertilizer only also included as treatments!. On the other hand, a very discreet trial carried out at Maha Illuppallama  in 2017(?) did not reveal any response to BFBF (Attachment 3)!

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**‘Toxin-free Agriculture’ and Microbial Fertilizer Technology Efficacy**

 **Dr Parakrama Waidyanatha The Island 4th March 2017**

The government’s new agriculture policy as enunciated in its policy document ‘Toxin –Free Nation- Three year Plan, 2016, is sadly full of errors and un-achievable objectives as pointed out in an incisive article titled ‘A toxin –free nation – Is it attainable’? in The Island of 25th January 2017by Dr Sarath Amasiri, a former Director General of Agriculture. IThe policy, among other things, stipulates replacing agrochemicals over a specified time frame( 3 years according to the document), with organic agriculture and microbial fertilizer technologies; and cultivation of 30% of the rice extent in traditional varieties. It is argued that traditional varieties(YVs) are more nutritious and of higher medicinal value than the new improved varieties(NIVs). This is not true and there are NIVs with comparable nutritive value. On the other hand, the staple food is fundamentally to provide the carbohydrates or calories the balance nutrition being essentially derived from other foods. Most importantly, NIVs yield, on average, four times more than the Tvs, and hence overexpansion of Tvs could negatively affect the national food production. Nobel Laureate Norman Borlaug, the Father of the Green Revolution in his address to the Nobel forum in 2000 remarked that, had the pre-green revolution global cereal yields (ca 1t/ha, also the yield of our traditional rice) prevailed today we would need nearly 1.8 billion hectares of additional land as against the current 600, 000ha to equal the present global harvest! Imagine the consequent environmental degradation! Agriculture can never be totally toxin free. Organic farming is not toxin free either! What needs to be done is to minimize toxins through judicious agrochemical use. Sadly the government has not addressed this matter effectively! Alternative more sustainable technologies to agrochemicals are now being widely researched on globally and should be vital for minimizing pollution, environmental degradation and the health of all living beings in the future. The world cannot, however, at least in the foreseeable future, feed its populace without agrochemicals! And that is a fact whatever the ‘toxin-free’ purists say! Norman Borlaug in the above address also remarked that half the world population today is alive thanks to the Haber-Bosch Process of synthesis of ammonia (nitrogen fertilizer)! Globally, however, only 1% of the agriculture is organic of which only 0.22% is in arable crops, less than 0.2% is in other crops, the bulk of the extent (0.66%) being in pastures. Organic agriculture is so restricted because of the inadequacy of organic matter or consistently reliable alternatives such as microbial technologies to provide optimum crop nutrient demands. Cuba was the only country in the world that was compelled to go totally organic in 1989 , with the collapse of USSR and consequent discontinuance of agricultural aid from it on which Cuba was nearly totally dependent. However, over the years it has returned in part to agrochemical technologies. It now uses chemical fertilizers increasingly, currently consuming 50 kg/ha/yr, and has its own glyphosate manufacturing enterprise!

**Microbial fertilizers and their efficacy**

The ‘toxin –free’ policy makers have realized that it is impossible to physically provide the requisite organic matter to produce the national food demand, and is resorting to microbial fertilizers as an alternative. The policy document states that local scientists have taken steps to provide robust non-toxic fertilizer, and many of them are being sold at competitive prices. It further states that the government will create an enabling environment for these manufacturers. In a report in The Island of 20th February titled ‘Lankan scientists come up with microbial fertilizer’ by Saman Indrajith, it is claimed that a ‘revolutionary product, which is a world’s first from Sri Lanka can replace up to 50% of the chemical fertilizer usage in major commercial crops, and increase yield by 20-30%’, ‘saving the country billions in foreign exchange’! The new product carries the name Biofilm Biofertilizer(BFBF), a microbial technology based on the principle that some microbes(bacteria, fungi and algae) have the tendency to attach to surfaces and form multiple cellular communities bound together by extracellular polymers referred to as biofilms, which are supposedly more effective than individual microbes in nutrition provision to crops. . Although it is claimed that this product is a result of ten years of research participated by various research institutions, there is as far as I am aware, published evidence of it being responsive with only young tea and rubber plants, but not with mature crops, in work done at the Tea and Rubber Research Institutes. On the other hand, research conducted at the Rice Research and Development institute of the DOA with this product, according to its officers did not give positive responses to it and more trials are now in progress. In an experiment conducted with maize at the Field Crops Research and Development Institute of the DOA at Mahailluppallama, BFBF did not improve plant growth or yield . Despite all this, the product is vigorously promoted by a firm as evident in The Island’s article referred to above. Furthermore, although claimed in the above article, there had been no research conducted with the Sugarcane Research Institute on BFBF according to its officials, and I have not seen any published research on the efficacy of this product from any of the other institutions mentioned in The Island’s article referred to above.

 I was, however, able to pick up the Table given below from published literature, from an article: Udugama, V.A et al (2016) ‘Biofilmed Biofertilizers - Application in Agroecosystems ; The Handbook of Microbial Bioresources: 96- 106; Commonwealth Agricultural Bureau International (eds V K Gupte et al)There are in all 15 authors in the publication. I have inserted in the last column of the Table, the mean crop yield data from 30 farms for Yala 2014 and Maha 2014/15 obtained from a DOA publication( Cost of Cultivation) for comparison. Clearly, something is seriously wrong with the trial crop yields in being often many fold less than the comparable farm yields despite the trial being repeated at several sites! For example, Hungarian Wax Pepper, tomato and cabbage research yields treated with BFBF are a mere 238, 335 and 1305 kh/ha, as against corresponding farm yields of 12, 617, 19,834, 27,935 kg/ha, that is, 53,59 and 21 fold lower than the corresponding farm yields respectively ! How come the research yields are so low! Is it an error? If so how did all 15 researchers/co-authors and even the editors/referees of the publication miss it! The design of the trial too is faulty in that the corresponding control treatments, viz, 50% fertilizer only and BFBF only had not been tested. Without the former treatment one cannot conclude that the BFBF had been efficacious. It is surprising that the journal has accepted this article for publication with these serious faults. Nevertheless, has the company got other adequate research evidence from trials ideally carried out in collaboration with the respective research institutions to enable recommending the products confidently? If not, is it not unethical on the part of the company to promote the product among farmers? That is not all! This product is being promoted in the website of the Strategic Enterprise Management Agency (SEMA) apparently the primary body promoting the concept of ‘toxin –free agriculture . How could any governmental organization ethically promote any commercial product without itself or a dedicated state institution’s adequate testing?

There are various microbial formulations in the market but they should be promoted among farmers only following adequate testing by the dedicated research institutions. Sadly, this does not seem to happen and farmers are being fooled into using various concoctions by agrochemical companies. The Ministry/Department of Agriculture should set up a regulatory authority in line with the Registrar of Pesticides to ensure that such products do not enter the market without adequate testing by the dedicated state institutions and approval by such an authority.

There is, however, now a massive research thrust by some agrochemical companies in the search for effective microbes for replacing agrochemicals. The agrochemical firms Monsanto and Novozymes appear to be leaders in this regard. The two companies have set up an enterprise, BioAg Alliance which is reported to have in 2016 concluded the world’s biggest soil microbial test programme of over 2000 different microbial seed coatings grown in some 500, 000 test plots across US from Louisiana to Minnesota. The early results are supposed to be promising in that the selected top five microbes increased corn yields by an average of 4 - 5 bushels per acre and soya yields by 1.5 bushels/ac. A microbial product, Novozymes’ Met 52, a fungus that limits vine weevils is already used in millions of acres There is no argument that such research should take high priority in the future given the universal need to cut down on agrochemicals for sustainability of future agriculture, but any new findings should be adequately tested before introducing to farmers. The global market of microbial fertilizers for 2017 was forecast to be 10 billion USD. Latin American and Europe are currently the top consumers of biofertilizer. In Mexico one microbial product is used now in some 1.5 million hectares. However, formulation of inocula that have a reliable and consistent effect under field conditions is still a serious challenge for their wider use.

**COMPARISON OF BIOFERTILIZER TRIAL YIELDS WITH STANDARD FARMER YIELDS**

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 **Crop \*\*Biofertilizer Trial Yields (Kg/ha) \*\*\*Farmer Yields (kg/ha)**

 **50% Chemical Fert. + BFBF\_\_100% Chemical Fert.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tea                                   4300 ± 606                        4100 ± 678 \_\_\_\_

Rice                                  4420 ± 715                        3580 ± 1295  6059 (Ampara)Y/I

Maize                                2681 ± 322                        2502 ± 338 8594 (A’pura) Y/I
 4571( -do-) M/R
Radish                               1192 ± 251                          992 ± 188 \_\_\_\_

Cabbage                            1302 ± 342                         980 ± 249 27,945(N’eliya) Y/I

Bitter gourd                      1547 ± 445                       1563 ± 440 13,343 (H’tota) Y/I

Aubergine                        748 ± 175                         678 ± 260 \_\_\_\_

Okra                                     3107 ± 1719                    1739 ± 710  \_\_\_

Chilli                                     3478 ± 1754                    2350 ± 919 17,618 (A’pura)Y /I
 7,116 (-do-) M/R
Hungarian wax pepper      238 ± 50                         152 ± 39 3 12,617 (Badulla) M/I

Tomato                                  335 ± 86                        397 ± 131 19,834 (Badulla) Y/I
Pole bean                            2762 ± 886                   2396 ± 753  11,330 ( -do-)Y/I
 5,782 (-do-) M/R**

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**\* Fertilizer recommended by the relevant institutions. \*\*Commonwealth Agric. Bureau J 2016**

**\*\*\* Average of 30 farms: Source - Dept of Agriculture; Cost of Cultivation Yala 2014& Maha 2014/15**

**Y = Irrigated R = Rainfed M = Maha season Y= Yala season**