myocardial stimulation is a common feature to the action of all the three adrenergic drugs, which indicates that both the α and β-adrenergic receptors are concerned in their augmentary action. This is further supported by the fact that both dihydroergot as well as inderol can block the augmentary action of the three adrenergic drugs.

In conclusion it appears that while isoprenaline is only stimulatory, adrenaline and noradrenaline exhibit a diphasic action on the piscine heart, inhibitory as well as augmentary. Of these, the inhibitory action is mediated through cholinergic nerve, more prominently during embryonic stage of development, presumably because the vagal tone is stronger at this stage. This action is mainly associated with the α and not with the β-adrenergic receptors. On the other hand the β-adrenergic receptors mainly mediate the augmentary action.

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RELATIVE RESPONSE OF THE RICE PLANT TO BLUE-GREEN ALGAE AND AMMONIUM SULPHATE IN BULK TRIALS

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AN experiment to demonstrate the efficacy of blue-green algæ in the nitrogen nutrition of the rice plant over the common fertilizer used in rice cultivation, *viz.*, ammonium sulphate, was laid out during *dalua* (December-April) 1964-65 in the Central Rice Research Institute. Two identical plots of 10 × 10 metres were chosen. To plot (1) ammonium sulphate at 30 kg. N/ha was applied after transplantation; to the second, plot (2) a basal dressing of lime at 1000 kg./ha + superphosphate at 30 kg. P_2O_5/ha was given and after transplantation sodium molybdate at 280 grams/ha and a blue-green algal mixture consisting of *Anabœna* sp. and *Nostoc* sp. (both nitrogen fixers) at 2 gm. dry weight/ha was applied. Fresh algæ from cultures of one of us (R.S.) were used.

Soon after application of ammonium sulphate, in the plot (1) concerned *Euglena* sp. and *Spirogyra* sp. (green forms of algæ) developed considerably. In plot (2) no green forms developed, but *Anabœna*, grew dominating the blue-green forms therein. Usually, as is the practice, when dried blue-green algæ are applied, it takes about 4 to 5 weeks for them to develop; in the present instance, where fresh algæ had been applied, their growth was evident soon.

Within a short period, about 4 weeks, a remarkable difference was noticed between the two plots; plot (2) showed more vigorous growth of the rice plants therein, the number of tillers in each hill being almost double the number compared with plot (1). This is attributable to the beneficial rôle of the blue-green algæ which besides supplying the nitrogen requirements of the plants, perhaps supply some growth-promoting substances as well and, further, suppress the growth of green forms of algæ as also weeds which consume the nutrition meant for the rice plant.[1-12]

It is well known that blue-green algæ liberate soluble substances of the nature of carbohydrates, polysaccharides, polypeptides, amino-acids, plant hormones such as auxin and also certain toxins.[13] It would appear that the better growth of the rice plant in the plots with blue-green algæ is due to the former category of substances and apparently the toxins do not affect the rice plant but exercise a deleterious effect on the green forms of algæ and several weeds in the field as these are found to have a set back when the blue-green algæ are conspicuously present. Further work

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on this rôle of the blue-green algæ would be rewarding.

However, after a short while, the leaves of the rice plants in both the plots began to turn yellow and into orange colour and it looked as though the crop was going to be a failure. This symptom appeared to us to be a "deficiency disease" owing to lack of some essential substances. Therefore, the water in the plots was drained out, and after a day, a very highly dilute solution of salts† containing Mo, Cu, Mn, Fe, Zn and B was sprayed over the soil surface in both the plots and water was let in. The crop showed signs of recovery and, therefore, the treatment was repeated once again as only very minute quantities of the elements had been given in the first instance. Thereafter, the crop picked up and thrived.

In one of our earlier accounts[6] we had referred to the possibility of trace elements being limiting factors for growth of the rice plant; the above treatment lends support to the rôle of trace elements.

The particulars relating to the crop and yield data are presented in Table I.

It may be seen that the blue-green algæ treatment has produced an increase of grain and straw yield of 24% and 23% respectively *over* the ammonium sulphate application. This is accounted for by the greater number of tillers, panicle length and grain weight (1000 grains). Therefore, the schedule of applying lime superphosphate, sodium molybdate and blue-green algæ is definitely a better and superior substitute for ammonium sulphate. Further, as pointed out by us elsewhere[10] the algal treatment promoted fertility build-up of the soil, leaving a *favourable residual effect* which supported two crops (may be it could be more) the yield being affected in no way; hence, it is an economical method as well.[10]

The other important point to be noted is the revival of the crop when trace elements were applied. The type of yellowing noticed is often met with in several parts of the country. This may also be due to depletion of the essential trace elements as a result of intensive continuous cultivation over centuries and attention being not paid to this aspect. Incidentally, it may be mentioned that such deficiencies might lower the resistance of the plants to diseases caused by various pathogens. Such a phenomenon is unusual in fields which had received green manure or other types of organic manures; obviously, these manures should be containing the required trace elements. The repeated use of mineral synthetic fertilizers, on the other hand, do not meet the whole requirement of the rice plant and the response to these fertilizers will depend on the availability of the trace elements in the soil which would act as limiting factors. It may be of interest to mention here that crops showing such symptoms often recover when flood water or polluted water enter the fields; evidently, *this* water must be bringing in some or most of the deficient elements.

† Solution of: $FeCl_3$ – 10 gm.; $MnSO_4$ – 3 gm.; H_3BO_3 – 10 gm.; $CuSO_4$ – 1 gm.; $ZnSO_4$ – 5g m.; and MoO_3 – 10 gm. in 1000 litres per hectare.

TABLE I

Yield of grain, straw and biometrical data Second Season (Dalua) 1964-65 (December-April)

	(1) Ammonium Sulphate @ 30 kg. N./ha.	(2) Lime 1000 kg./ha. + Superphosphate 30 kg. P_2O_5/ha. + Sodium molybdate 0·28 kg./ha. + blue-green algæ (*Nostoc* sp. and *Anabæna* sp.)
1. Height in cms. ..	114·2	120·7
2. Ear bearing tillers per 0·45 sq. m.	89 (100%)	103 (116%)
3. Panicle length in cm.	18·8	20·5
4. 1000 grain weight in gm.	21·7	22·3
5. Grain yield kg./ha. ..	2600 (100%)	3225 (124%)
6. Straw yield kg./ha. ..	3100 (100%)	3800 (123%)

Other particulars:

1. Variety TKM 6; 2. Date of sowing nursery: 12-12-64; 3. Plot size: 10 metres × 10 metres = 100 sq. m.; 4. Date of transplanting: 23-1-65; 5. Spacing: 15 cm. × 15 cm.; 6. Date of harvesting: 26-4-65.

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