III. RESULTS AND DISCUSSION
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A - Chemical analysis:

The characteristics and composition of the seeds and oil of *Couroupita guianensis* Aubl. are given in table no. 84 (Fig. 21). The seeds are oval and brownish in colour. The oil content in the seeds is very high (32%). The protein content was appreciable (19.0%). The GLC analysis showed that the predominant acid in seed was linoleic (81.5%). On the basis of fatty acid composition oil can be classified as drying type (Lakshminarayana, 1968).
In one year old oil of *C. guianensis* (Table 85, Fig. 22), the colour was changed from brownish yellow to yellow and the acid value was changed from 2.4 to 13.3 and Iodine value from 126.1 to 118.3. There was decrease of about 10% in linoleic acid.

The characteristics and composition of the seeds and oil of *Momordica charantia* are given in table no. 86 (Fig. 23). The oil content in the seeds is very high (30%). The protein content was appreciable (45%). The GLC analysis showed that the predominant acid in seed was stearic acid (74.4%). On the basis of fatty acid composition oil can be classified as non-drying (Lakshminarayana, 1968). The most important characteristic of *M. charantia* (Wild variety) is that it contains lower %age of C$_{18:3}$ acid while other variety of *M. charantia* contains higher proportion of C$_{18:3}$ acid (Conacher et al., 1970).

The characteristics and composition of seeds and oil of *Moringa oleifera* (Root) are given in table no. 87 (Fig. 24). The oil content in the root was less (2.0%). The GLC analysis showed that the predominant acids in the roots were C$_{12:0}$, C$_{12:1}$ and C$_{16:0}$ (12%). On the basis of fatty acid composition, the oil can be classified as non-drying (Lakshminarayan, 1968).
Characteristics and composition of seeds and oil of *M. oleifera* (seeds) are given in table no. 88 (Fig. 25). The oil content in the seeds are very high (29.3%). The protein content was appreciable (38.4%). The GLC analysis showed that the predominant acid in the seed was linoleic acid (77.27%). On the basis of fatty acid composition the oil can be classified as non-drying (Lakshminarayan, 1968).

The characteristics and composition of the seeds and oil of *Diplocyclos palmatus* (L.) C. Jaffery are given in table no. 89 (Fig. 26). The oil content in the seeds is relatively low (12%). From the R.M. value, polenske value and Iodine value, it is clear that the lower fatty acids are absent and the proportion of unsaturated acids are relatively higher and this observation is also supported by GLC data. On the basis of fatty acid composition the oil can be classified as drying type (Lakshminarayana, 1968).

The characteristics and composition of seeds and oil of *Daucus carota* are given in table no. 90 (Fig. 27). The oil content in the seeds is relatively low (12.3%). The protein content was appreciable (36.9%). The GLC analysis showed that the predominant acid in seed was linoleic (59.91%). On the basis fatty acid composition oil can be classified as non-drying type (Lakshminarayana, 1968).
B - Effects of extracts on induced spawning:

(i) Couroupita guanensis Aubl.

With a view to examine the effect of ECG on the breeding pattern of mrigal and rohu in confined water, 27 sets of mrigal and 20 sets of rohu were injected with ECG AGG or PG as first dose in different combinations with ECG, PG, EMOS, EMC EDC oxytocin, HCG, ALR or EMQR in second dose.

(a) Mrigal: Out of 27 sets of mrigal, 9 sets failed to respond, 3 sets were plugged, 6 sets showed partial breeding whereas 9 sets yielded full response.

The female was plugged when two capsules containing 900 mg ECG were orally administered and one capsule of 900 mg to each male (Table-1). The plugging indicated that extract was effective but may be due to overdose there was plugging. There was no breeding when mrigal was injected with 0.2 ml ECG in first and second dose. The eggs were oozing out from the vent. While on the other hand the set injected with PG in the both the doses (PG control set) showed full response producing 1,50,000 eggs with 30% fertilization (Table-2). One of the reasons for the failure of ECG injected set might be insufficient dosage. In
Fig.: 21
Gas chromatograph of fatty acids in Couroupita guianensis
Fig: 22
Gas chromatograph of fatty acids in *Couroupita guianensis* (old)
Fig. 23: Gas chromatograph of fatty acids in Momordica charantia
Fig. 24: Gas chromatograph of fatty acids in Moringa oleifera (Root)
DETECTOR RESPONSE
RETENTION TIME (Min.)

32 x 100
C183 C189
C181
C184
C186

Montana oilseed
Fatty acids in
Gas Chromatograph

FIG. 22
Retention time (min)

Detector response

G cis chroma

3.2 x 1000

C18:3

C18:2

Diplopyclen, palmitic

Fatty acids in

Gas chromatograph

Fig. 26
DETECTOR RESPONSE

Fig. 27
Gas chromatograph of fatty acids in Daucus carota

Retention Time (Min.)

C_{16,0}
C_{18,0}
C_{18,1}
C_{18,2}

32 X 100
continuation, a knock-out dose of 1.8ml of ECG resulted in plugging under heavy rain condition. There was plugging in control (PG injected) set also. The plugging may be due to overdose or more potency of PG in PG injected sets and overdose of injected oil in ECG injected set at a time (Table-4).

The results of Table-50 show that out of two sets injected with 0.6ml and 0.8ml ECG in first and second dose respectively to female, and males with 0.5ml of ECG, one set showed full response producing 2,20,000 eggs with 60% fertilization while other set responded partially producing 5000 eggs with no fertilization. On the other hand PG injected set responded fully producing 4,80,000 eggs with 90% fertilization.

If we compare the number of eggs, the PG injected female was large with weight of 2.2 kg while the ECG injected female was of 1.5 kg. The reason for partial response might be poor gonadial development, more over the smaller size of the male might have resulted into failure in embracing, twisting, rubbing and nudging the female. Coiling and intertwining of the two partners exert pressure on the abdomen of the mating pairs resulting in the extrusion of ova and exudation of milt. The small size of males, in the present study might have resulted in
failure in mating and oozing of milt and therefore, partial spawning with no fertilization was observed.

Three sets of mrigal were injected with ECG in first and second dose. There was full breeding in PG injected as well as in one of the ECG injected sets producing 2,80,000 and 2,30,000 eggs with 80% and 70% fertilization respectively. The fertilization in ECG injected set was 10% lower than the PG injected set because of the small size of the males as observed earlier (Table 51). There was partial breeding in one set producing 50,000 eggs with 25% fertilization. In this case quite possibly the males have not worked properly as there was partial breeding as well as poor fertilization. The third set showed plugging. This set was fully mature when injected with first dose. Plugging might be due to hyper doses or any other physiological factor.

The results of Table 72 show that when ECG was injected in both the doses, there was plugging while PG control set yielded partial response producing 75,000 eggs with 70% fertilization. The failure of ECG injected set either may be due to high atmospheric temperature as reported by Khan (1945) and Chaudhuri (1960) or due to hyper dose. The partial breeding in PG injected set might
be due to high temperature or low potency of the gland.

The results of Table-5 show that there was full breeding in PG-control and ACG-PG injected sets. In these sets, apart from the good weather condition, hapa was fixed in the pond no. 2 against the water diverted from the canal, so the flow of water provided stimulus of reverine condition. There was full-spawning producing 6,00,000 eggs with 40% fertilization in PG control set. The poor fertilization might be due to small size of males. Whereas there was full breeding producing 4,00,000 eggs with 99% fertilization in ACG-PG injected set.

A combination of ECG-EMOS under heavy rains resulted into full spawning producing 2,80,000 eggs with 40% fertilization and PG injected set produced 4,00,000 eggs with 80% fertilization (Table 6). Thus ECG was found effective for induced spawning in fishes in combination with EMOS.

A similar combination under low rain fall and artificial showering produced 2,10,000 eggs with 70% fertilization where as second set responded partially with 70,000 eggs and 90% fertilization. In PG injected set there was full breeding producing 2,50,000 eggs with 90% fertilization (Table 28). Regarding the partial response there are two possibilities that the dose of EMOS might be
slightly low or the eggs might be in the fourth stage of maturation.

Out of two sets administrated with ECG-EMC, one showed full breeding producing 1,20,000 eggs with 60% fertilization. Simultaneously there was full breeding producing 4,00,000 eggs with 80% fertilization in PG-control set (Table 6) while the same combination under dry condition showed no response (Table 7). The PG injected control set yielded only 45,000 eggs with 50% fertilization. This failure might be due to high temperature which supports the views of earlier workers (Chaudhuri, 1960; Chaudhuri et al., 1966, 1967). There was absolutely no response when mrigal was administered with ECG-EDC under good weather condition whereas there was full breeding with 80% fertilization in control set as described earlier (Table-6). The lack of response of ECG-EDC injected set might be due to ineffectiveness of EDC because other two sets of ECG responded fully when injected with EMC and EMOS (see Table 6). The results of Table-7 shows that under dry condition with water temperature being 32°C, the ECG-EDC and PG control set failed to respond. The failure of ECG-EDC might be due to ineffectiveness of EDC or high water temperature.
Out of 4 sets injected with ECG-PG combinations under favourable conditions of normal rain, one set produced 4,50,000 eggs with 99% fertilization while in PG-control set there was full-breeding producing 4,00,000 eggs with 90% fertilization. This was only the case in which the eggs were bigger compared to PG injected sets. The reason for the bigger eggs is unknown (Table 14). The another set produced 1,60,000 eggs with 95% fertilization while in PG control set there was partial response producing 80,000 eggs with 95% fertilization. The partial breeding may be due to low potency of gland and we had placed only one male in the breeding hapa (Table 15).

In the third set there was no response in ECG-PG injected set while there was plugging in PG control set (Table 69). Similar failure was observed in ECG-PG injected set under dry atmospheric condition. The PG control set showed partial response producing 45,000 eggs with 50% fertilization (Table 71). Lack of response of ECG-PG sets might be due to high temperature or low potency of gland.

A reverse combination of PG-ECG under cloudy atmosphere without rain yielded partial breeding without fertilization where as there was full breeding in PG
control set producing 2,50,000 eggs with 70% fertilization (Table 9). The reason for partial breeding might be low potency of gland or poor response of males as there was negligible production of eggs and no fertilization.

When oxytocin was administered as second dose subsequent to ECG there was partial breeding in both the sets producing 60,000 and 90,000 eggs with 50% and 40% fertilization respectively. The PG control set produced 2,20,000 eggs with 80% fertilization (Table 48). These observations lead us to believe that the effect of oxytocin may not be prolonged as in case of PG and therefore it may result into partial response. ECG with HCG (1500 IU) as second dose and simultaneous injection of males with HCG (500 IU) yielded no response, whereas HCG control set produced 10,000 eggs with no fertilization (Table 65).

The combination of ECG-ALR and ECG-AAR yielded no response. The PG control set also did not respond (Table 70). In this case the total failure was found to be due to some physiological problem because on dissection of the female it was observed that ovaries were in the 4th stage of maturation and moreover the water temperature (32°C)
again was not favourable and therefore it might have resulted in negative response (Fig. 20).

(b) Rohu: There was no response when ECG was employed in both the doses (Table 3) where as out of two PG control sets, one showed full breeding producing 1,20,000 eggs with 40% fertilization and another set failed to respond.

Under heavy rain condition, the alcoholic extract of C. guianensis (ACG) in first dose and PG in second dose yielded partial response producing 1,20,000 eggs 80% fertilization. The PG control set also responded partially producing 2,50,000 eggs with 70% fertilization (Table 7).

The results of Table 8 showed that a set administered with ACG in first and second dose yielded partial response producing 10,000 eggs with negligible fertilization. There was excellent response in PG control set producing 5,80,000 eggs with 80% fertilization.

A set with ECG as first dose and AMC as second dose showed partial response producing 80,000 eggs with 40% fertilization. The PG control set yielded full spawning producing 3,20,000 eggs with 75% fertilization (Table 82). On dissection, it was observed that the reabsorption of ova had already begin in ECG-AMC administered set and
possibly due to this reason there was partial response (Fig. 19).

Under heavy monsoon condition, a combination of ECG in first dose and PG in second dose yielded 8,00,000 eggs with 70% fertilization and another set produced 2,40,000 eggs and 80% fertilization (Table 49). The PG control set also responded excellently producing 4,60,000 eggs with 60% fertilization. This was found to be the best combination for induced breeding as two sets of mrigal produced total 10,40,000 eggs. The ECG-PG combination was yielded good response as compared to PG-PG or HCG-HCG combination. This combination can replace the 50% of the requirement of PG. On reversing the pattern of administration with PG in first dose and ECG in second dose following results were obtained. Out of three sets, one showed full breeding producing 2,00,000 eggs with 80% fertilization. Second set was plugged (Table 52). The PG control set produced 2,10,000 eggs with 90% fertilization. The third set showed 50% fertilization with production of 40,000 eggs (Table 10).

Four sets of rohu injected with ECG in first dose and second dose of oxytocin (0.5ml) and a normal dose of PG to male in all the sets, showed that there was partial
breeding producing 10,000 to 80,000 eggs and from zero to 50% fertilization (Tables 21, 47, 66). The PG control sets also yielded 20,000 to 2,80,000 eggs with zero to 90% fertilization.

It was constantly observed that in any combination oxytocin always stimulated the fish for partial response. The partial response might be due to immediate and shorter duration effect of oxytocin.

Out of three sets injected with ECG in first dose and HGG in second dose under good climatic conditions, two showed partial breeding with 80,000 and 40,000 eggs and 80% and 20% fertilization respectively whereas the third set failed to respond. The HCG-control set also showed partial response producing 1,30,000 eggs with 70% fertilization (Table 53).

There was absolutely no response when ECG was injected in first dose and ALR in second dose. The PG control set also was plugged (Table 36). The failure of ECG-ALR set might be due to ineffectiveness of ALR in induced breeding as stated earlier. The combination of ECG and EMGR resulted in production of 70,000 eggs with 20% fertilization. The PG control set showed plugging (Table 36). There was no response in the set injected with ECG in first dose and ECG-PG in second dose. The PG control set also failed to respond (Table 80).
(c) *Cyprinus carpio*: In case of *Cyprinus carpio* which normally breeds in confined water, there was no response inspite of keeping both the male and female together for a period of 4 days. Moreover, a single dose of ECG to both males and female yielded no response (Table 60).

(ii) *Momordica charantia* L.

In order to study the effects of ether and alcoholic extracts of seeds of *Momordica charantia* on the breeding pattern of major carps, 19 sets of rohu, 19 sets of mrigal and 3 sets of catla were injected with EMC, AMC or PG in first dose followed by alternate second dose of PG, EMC, EMOR, ECG, HCG, EMOS, AAR, ALR, EDC or oxytocin,

(a) *Mrigal*: Eight sets of mrigal were injected in good climatic condition with EMC in first dose (0.6ml) followed by second dose of PG to both males and females. Out of these, two sets showed full response producing 2,80,000 and 2,30,000 eggs with 80% and 70% fertilization respectively. Four showed partial breeding producing 50,000 to 80,000 eggs with 30% to 95% fertilization (Tables 11, 12) whereas the remaining two sets did not show any response (Tables 15, 69). The PG control sets showed full breeding.
producing 3,50,000 eggs with 70% fertilization (Table 11) and 2,10,000 eggs with 90% fertilization (Table 12) while the PG control set was plugged under dry climatic condition (Table 69) and there was partial response producing 80,000 eggs with 95% fertilization under good climatic condition (Table 15). The exceptionally good results of M. charantia might be due to its abortifacient properties as reported by Kirtikar and Basu, 1933; Nadkarni, 1954; Chopra et al., 1956, 1958; Saha et al., 1961; Vaidya, 1965.

Out of three sets injected with PG-EMC combination under cloudy weather, one set showed full breeding producing 1,90,000 eggs with 60% fertilization and the other set responded partially producing 20,000 eggs without fertilization whereas the third set failed to respond. On the other hand the PG control set yielded full response producing 2,40,000 eggs with 80% fertilization (Table 13). Lack of response and partial response in the PG-EMC sets might be due to failure of males because on dissecting the females, the oviduct was found to contain large number of mature eggs.

A combination of EMC as first dose and ACG as second dose, under rainy condition resulted in partial spawning producing 70,000 eggs with 80% fertilization. The PG
control set produced full breeding yielding 2,20,000 eggs with 60% fertilization (Table 34). The partial response with 80% fertilization might be due to insufficient doses to female as the response of male was otherwise excellent.

A set injected with EMC in first dose and HCG in second dose yielded no response whereas HCG-control set yielded partial response with no fertilization (Table 65). The failure of EMC-HCG and HCG control set might be due to low potency of the dose.

The results of Table 33 showed that EMC in first dose and EMOS in second dose in good atmospheric condition produced 20,000 eggs with no fertilization. The PG control set also failed to respond. There was also no breeding in EMOS-EMC combination (Table 54) so this EMOS-EMC or EMC-EMOS combinations might be less effective for inducing the fish to breed.

A set with EMC-AAR combination showed no response. There was absolutely no spawning in third set administered with EMC and ALR in first and second dose respectively. There was no spawning in PG control set as stated earlier (Table 33). The failure of EMC-AAR and EMC-ALR sets might be due to ineffectiveness of AAR and ALR extracts as
there was no response when ALR was injected with EMC (Tables 34, 44) and AAR with EMC (Table 43).

There was no breeding in the set administered with EMC in first dose and EDC in second dose. The PG control set also showed partial response producing 40,000 eggs with 20% fertilization (Table 35). The failure of EMC-EDC dose might be due to ineffectiveness of EDC because the reverse combination of EDC-EMC did not produce any positive response (Table 24).

Partial breeding producing 65,000 eggs with 40% fertilization was observed with injection of EMC-EMOR combination. The PG control set also responded partially in this case (Table 35). The partial response might be due to insufficient doses because the reverse doses of EMOR-EMC had produced 1,80,000 eggs with 90% fertilization (Table 22).

(b) Rohu: Two sets of rohu administered with EMC as first and second dose under cloudy weather showed partial response in one set producing 70,000 eggs with 80% fertilization whereas the other set failed to respond. The PG control set also showed partial response producing 90,000 eggs with 70% fertilization (Table 56). The partial
response probably might be due to the fact that the experiment was carried out at the end of the breeding season.

Out of three sets injected with AMC in first and second dose under dry atmospheric condition and artificial showering, two sets showed plugging and third set failed to respond, whereas PG control set yielded partial response producing 80,000 eggs with 60% fertilization (Table 77). On dissecting the female breeders, the beginning of reabsorption of the ova was observed.

The female was plugged when injected with EMC in first dose and PG in second dose. The PG control set produced 2,50,000 eggs with 70% fertilization (Table 7). The EMC-PG or the reverse PG-EMC combination was not so effective in inducing breeding in rohu (Tables 10, 61).

The combination of EMC and PG resulted in partial breeding producing 60,000 eggs with 60% fertilization and a combination of EMC with EMOR yielded no response. The PG control set also showed partial response producing 1,10,000 eggs with 40% fertilization (Table 23). The partial response of EMC-PG, EMC-ECG and no response with EMC-EMOR combinations may be due to the beginning of reabsorption of the ova since the experiments were carried
out at the end of the breeding period of major carps. Similarly a combination of EMC in first dose and ECG in second dose showed partial breeding in one set yielding 1,20,000 eggs with 40% fertilization whereas second set showed plugging (Tables 23,82). The PG control set yielded full response producing 3,20,000 eggs with 75% fertilization in one set and partial response producing 1,10,000 eggs with 40% fertilization as reported earlier (Tables 23,82).

Tables 29 and 66 show the effect of application of EMC in first dose and oxytocin (0.5ml) to female and a normal dose of PG to males at Navali and Lingda farms. The results show partial breeding producing 40,000 eggs and no fertilization at both the places suggesting the ineffectiveness of the combination. The PG control set at Lingda farm produced partial response with 30,000 eggs and no fertilization while at Navali farm it yielded 2,70,000 eggs with 85% fertilization. The reason for such a remarkable difference may be attributed to the potency of the PG extract used at both the places. Five sets of rohu were injected in dry condition with first dose of EMC followed by second dose of HCG, none showed any response (Tables 57,58). Out of the two HCG control sets, one
showed partial response producing 60,000 eggs whereas the other failed to respond. This failure might be due to end of the breeding season.

(c) Catla: Two sets of catla injected under rainy conditions with EMC in first dose and EMQR in second dose yielded no response (Table 62). The PG control set also failed to respond. The lack of response of EMC and EMQR set might be due to ineffectiveness of combination. Similar results were obtained when EMC was administered in first dose and ECG in second dose under raining condition and with artificial showers at Lingda fish farm (Table 62).

(d) Common carp: With a view to examine the effect of EMC on the breeding pattern of Cyprinus carpio, a single dose of EMC when injected to both males and female resulted in production of 50,000 spawns which otherwise did not show any response contrary to its normal tendency of breeding in confined water. (Table-59).

(iii) Moringa oleifera Lam. (Root)

In order to study the effects of ether and alcoholic extracts of roots of Moringa oleifera on the breeding pattern of major carps, 8 sets of mrigal, 6 sets of rohu and 3 sets
of catla were injected with EMOR, AMOR in first dose followed by EMOR, ECG, EDC, EMC, PG, EMOS, AAR, ALR, ACG, HCG or oxytocin in second dose.

(a) Mrigal: The mrigal female was plugged when injected with 0.8 ml/kg EMOR in first dose followed by 1.2 ml/kg EMOR in second dose to female and 0.6ml/kg to male under dry weather condition. PG-control set also was plugged (Table 83). The plugging might be due to high temp. of atmosphere or hyper dose of EMOR. On dissection, it was observed that both the female breeders were fully mature and showed signs of reabsorption of ova. Further, the damaged scales of breeder indicated good response of males. EMOR in combination with PG in second dose showed no response whereas the PG control set showed partial response producing 40,000 eggs without fertilization (Table 67). The partial response of PG-control set might be due to high temperature (30°C) or low potency of the PG extract. Lack of response of EMOR-PG injected set might be due to low potency of gland or ineffectiveness of EMOR or high temperature.

Three sets of mrigal were injected with EMOR in first dose in cloudy atmosphere with EMOS in first set, AAR in second and ALR in third set as second dose.
Table 30 shows that EMOR-EMOS injected set exhibited partial breeding producing 10,000 eggs without fertilization whereas set injected with ALR and AAR in second dose failed to respond. On the other hand PG-control set showed full breeding producing 2,10,000 eggs with 50% fertilization. EMOR-EMOS combination showed partial response may be due to abortificient, emmenagogue and ecbolic properties of *M. oleifera* as reported by Saha *et al.* (1961).

A combination of EMOR as first dose and ACG as second dose under cloudy condition resulted into partial spawning producing 30,000 eggs with no fertilization (Table 32). Further, combination of EMOR-HCG yielded no response and there was no spawning in the set injected with EMOR in first dose and ALR in second dose whereas PG control set yielded 2,40,000 eggs with 95% fertilization (Table 32). The reason for partial response of EMOR-ACG set might be due to (a) failure of male or (b) under dose of ACG failed to prepare the female for spawning. EMOR-HCG administration also failed to generate any response. EMOR-ALR set failed to spawn might be due to ineffectiveness of ALR as described earlier.
(b) Rohu: Three sets of rohu were injected with EMOR as first dose and EMC, ECG and EDC as second dose in first, second and third set respectively. EMOR-EMC combination resulted into full spawning producing 1,80,000 eggs with 90% fertilization. EMOR-ECG set responded partially producing 70,000 eggs with 20% fertilization and a third set of EMOR-EDC combination failed to respond. The PG control set showed full response producing 2,30,000 eggs with 80% fertilization (Table 22). The full breeding of EMOR-EMC combination producing 1,80,000 eggs with 90% fertilization might be due to abortifacient, emmenagogue and ecbolic properties of *M. oleifera* as reported by Kirtikar and Basu (1933), Grevel (1953), Nadkarni (1954), Chopra et al., (1958), Saha et al. (1961) and Vaidya (1965) whereas *Momordica charantia* acts as a sexual tonic as reported by Kirtikar and Basu (1933) and the roots and plant juice show abortifacient properties (Saha et al., 1961; Vaidya, 1965).

The partial response of EMOR-ECG combination might be due to poor response of males as there was only 20% fertilization while no response of EMOR-EDC combination might be due to reasons described earlier for EDC sets. There was partial response producing 70,000 eggs with 70%
fertilization when EMOR was injected as first dose and oxytocin as second dose to female and a normal dose of PG to males (Table 31).

There was partial breeding producing 60,000 eggs with 40% fertilization in the set injected with AMOR in first dose and PG in second dose. There was also partial breeding in PG control set (Table 31).

(c) Catla: There was absolutely no spawning when 3 sets of catla were injected with EMOR in first dose followed by ECG in first, EMC in second and EDC in third set as a second dose under rainy condition. The PG injected sets also failed to respond (Table.63).

(iii) Moringa oleifera Lam. (seeds)

In order to examine the effects of ether extract of seeds of Moringa oleifera on the breeding pattern of major carps, 15 sets of mrigal, 10 sets of rohu and 2 sets of catla were injected with EMOS in first dose followed by second dose of EMOS, PG, oxytocin, HCG, ECG, EMC, AAR, ALR, ACG, EDC or EMOR.
(a) Mrigal: There was partial response producing 60,000 eggs with 60% fertilization when EMOS was employed in both the doses under heavy rains. The PG control set yielded 2,00,000 eggs with 30% fertilization (Table 27). The partial response of EMQS set might be due to insufficient doses or low effective doses. The second set under similar condition yielded no response whereas the PG control set yielded full response producing 2,50,000 eggs with 90% fertilization (Table 17). The reason for the failure in one set might be due to inadequate dose or low effectiveness of extract.

A combination of EMOS in first dose and EMOR as second dose under good climatic condition failed to respond (Table 78). The PG control set also failed to respond. The total failure in this case was found to be due to (1) over crowding of the breeders in Navli fish farm (2) lack of segregation of male and female breeders (3) moreover, the ovaries in catla and rohu were found to be immature.

It is difficult to say as to why the ovaries remained immature despite the fact that it was almost end of the breeding season.
Further C.I.F.E. (Central Inland Fisheries Education), Bombay had also conducted several experiments at the Navali fish farm during this period and their results also showed the same failure.

Three sets of mrigal administered with EMOS and PG under different set conditions showed no spawning (Tables 15, 18, 69) while PG control sets produced 80,000 and 2,80,000 eggs with 95% and 75% fertilization whereas third PG control set showed plugging. The failure of EMOS-PG sets might be due to low effectiveness of extract.

The reverse combination of PG-EMOS yielded 30,000 eggs with 60% fertilization (Table 20). The PG control set also showed full breeding with 50% fertilization. The partial response might be due to similar reasons described earlier for EMOS-PG sets.

There was absolutely no spawning when EMOS injected in first dose followed by ECG in second dose (Table 71). The PG control set also showed partial response producing 45,000 eggs with 50% fertilization. The failure of EMOS-ECG set might be due to high temperature of the atmosphere and sunny day because in reverse combination, out of three sets injected with ECG-EMOS, two showed full breeding and one showed partial response (Tables 6, 28).
Further combination of EMOS-HCG administered under good atmospheric condition did not show any stimulatory effect (Table 65). HCG-control set responded partially producing 10,000 eggs with no fertilization whereas in combination with other extracts it failed, (Tables 32,38, 43,45,57,58 and 64). Only two sets showed partial response (Table 53).

Table 39 indicates that three sets administered with EMOS in first dose followed by AAR in first set and ALR in second and third set, none showed any response. PG control set yielded partial response with 80% fertilization. The total failure of EMOS-AAR and EMOS-ALR combinations are due to ineffectiveness of ALR and AAR extracts because none of the extract had shown any positive response with any combination.

Out of three sets injected under dry condition with EMOS in first dose and second dose of ACG in first set, EDC in second set and EMOR in third set, showed that there was partial breeding in ACG and EMOR injected sets producing 70,000 eggs with 30% fertilization and 30,000 eggs with 20% fertilization whereas EDC administered second set failed to respond. PG control set yielded full breeding producing 1,60,000 eggs with 80%
fertilization (Table 40). The partial response of EMOS-ACG combination might be due to insufficient doses because on the other hand ECG injected sets showed full breeding (Tables 6, 28). The partial response of EMOS-EMOR combination might be due to less efficiency of either EMOS- or EMOR or inadequate doses because the reverse combination of EMOR-EMOS also resulted in partial response with no fertilization (Table 30). The total failure of EMOS-EDC set might be due to ineffectiveness of EDC as observed in earlier cases (Tables 16, 17, 18, 24, 29, 37, 38, 68).

(b) Rohu: Three sets of rohu were injected in different set condition with EMOS as first and second dose. There was no response in the set injected in heavy rain whereas PG injected set showed full breeding producing 3,40,000 eggs with 95% fertilization (Table 16) whereas set injected in cloudy atmosphere showed partial response producing 10,000 eggs with 10% fertilization. The PG control set also showed partial breeding producing 30,000 eggs with 10% fertilization (Table 54) and a third set injected under cloudy atmosphere and heavy rain failed to respond. The PG control set yielded 1,20,000 eggs with 80% fertilization. The second PG control set showed partial response producing 80,000 eggs with 75% fertilization (Table 75). Three
sets administered under different set condition with PG as first dose followed by EMOS in second dose, showed partial spawning in one set yielding 10,000 eggs with no fertilization (Table 19), whereas two sets failed to respond (Tables 10, 61). The PG control set yielded excellent spawning producing 4,20,000 eggs with 85% fertilization. The reverse dose of EMOS-PG also yielded no response when injected under good rain after second dose while PG control-set producing 2,50,000 eggs with 70% fertilization (Table 7). The failure of EMOS-PG set might be due to less-effectiveness of the extract of \textit{M. oleifera} seeds. When oxytocin was administered as second dose subsequent to EMOS in two sets in different set condition, first set produced 20,000 eggs without fertilization while PG control set yielded 2,70,000 eggs with 85% fertilization (Table 29). Second set also responded partially producing 35,000 eggs with no fertilization. The PG control set showed partial response producing 30,000 eggs with no fertilization (Table 66). The partial response of EMOS-oxytocin-PG combination might be due to less effectiveness of EMOS and a shorter-duration effect of oxytocin.

There was absolutely no response when EMOS injected
in first dose followed by EMC in second dose under cloudy atmosphere (Table 54). The PG control set also responded partially. The lack of response might be due to beginning of reabsorption.

(c) Catla: Table 55 shows that out of two sets injected with EMGS in first and second dose under good climatic condition one showed partial response producing 25,000 eggs with 40% fertilization, while other set failed to respond. The PG control set also yielded partial response producing 90,000 eggs with 40% fertilization. The poor response of EMOS injected set might be due to inadequate doses and partial response of PG injected set might be due to low potency of the gland or insufficient doses.

(iv) Diplocyclos palmaus (L.) C. Jaffery

(= Bryonopsis laciniosa Naud; Bryonia laciniosa L.)

With a view to examine the effect of EBL on the breeding pattern of rohu in confined water, 10 sets of rohu were injected with EBL or ABL in first dose followed by ECG, EMOR, oxytocin, EMOS, AAR, ALR, ABL, PG, ADC or EBL in second dose.
(a) Rohu: Under heavy monsoon condition, a set with ABL as first dose and ECG as second dose showed partial response producing 70,000 eggs with 30% fertilization. A combination of ABL in first dose and EMOR in second dose showed partial response producing 40,000 eggs with 50% fertilization while oxytocin administered as second dose subsequent to ABL with a normal dose of PG to males, yielded partial breeding producing 90,000 eggs with 60% fertilization. On the other hand PG-control set also showed partial breeding with production of 50,000 eggs and 20% fertilization (Table 74). There is a comparatively good spawning and fertilization in oxytocin injected sets, but as stated earlier, the effects of oxytocin may not be prolonged as in case of PG and therefore, it might have resulted into partial response. The reasons for partial breeding in PG, ECG and EMOR (second dose) injected sets may be due to under dose otherwise the weather condition was excellent. The vent and belly of the female breeders were exceptionally good.

There was absolutely no response when EBL was injected in first dose and EMOS in second dose under good atmospheric condition. In two sets injected with EBL in first dose and AAR and ALR in second dose, there was
no response (Table 76). Lack of response of EBL-ALR combination shows that ALR—may be under dose or it may be devoid of the substance stimulating egg maturation or contraction of muscles of oviduct. The failure of EBL-EMOS injected set can be attributed to reabsorption of eggs. All the four sets examined showed reabsorption of eggs.

Administration of ABL in first and second dose in rohu under good atmospheric condition failed to create any response (Table 79). PG injected set also failed to respond. On dissection of the breeder, it was found that the ovary was immature in all the sets. Normally breeding seasons of major carps end in the third week of August and reabsorption of eggs begins but in the year 1985 at Navli fish farm, there was failure in most of the cases because of lack of development of the ovaries.

The reasons for poor development of ovary might be (1) starvation in the month of April, May and June or (2) over crowding of the breeders. Moreover the breeders were found to be infected with Argulus, the most common carp lice which feeds on the host blood and other tissue fluids by making rasping wound with their mandibles.

The female was plugged when EBL was injected in first and second dose under dry weather (Table 83). The PG control set was also plugged. The failure of the EBL and PG injected sets was again found to be due to the immature nature of the ovary.
There was partial response producing 40,000 eggs with 20% fertilization when ABL was administered in first dose and PG in second dose. The PG controlled set also showed partial response yielding 70,000 eggs with 50% fertilization (Table 81).

There was absolutely no response when ABL was injected with ADC in first and second dose respectively (Table 82), but PG control set produced 3,20,000 eggs with 75% fertilization. The no response of ADC injected set might be due to relaxant effect of the extract on wall of uterus as observed by Bhargava et al. (1967); moreover, it has also been shown to have CNS depressing action in rat and fish. This lead us to believe that the lack of response in ADC injected set might be due to its aforesaid properties.

(v) Daucus carota L.

Several workers have studied the chemical and pharmacological properties of Daucus carota. It has been shown that D. carota possesses abortifacient, ecbolic and emmenagogue properties (Nadkarni, 1954; Chopra et al., 1958; Saha et al., 1961; Vaidya, 1965) and antifertility activity (Garg and Garg, 1970; Garg 1973; Krishnarao et al., 1982). This prompted us to examine the effect of ether
and alcoholic extracts of *D. carota* on the breeding pattern of major carps.

In order to study the effects of alcoholic and ether extracts of fruits of *D. carota* on edible fishes, 11 sets of rohu and 9 sets of mrigal were injected with ADC or EDC or PG as first dose followed by ADC, EDC, PG, ECG, EMOR, HCG, ALR, AAR, ACG, HCG and oxytocin in second dose.

Pooling of the results obtained after administration of ether and alcoholic extracts of *D. carota* alone and in combination with the aforesaid plant extracts lead to believe that inspite of its reported abortifacient, ecobic and emmenagogue properties, *D. carota* extract is ineffective in inducing breeding in the major carps (Table nos. 16,17,18,19,20,24,29,37,38,68,73,75,79,81).

(vi) *Leptadenia reticulata* Retz.

In order to study the effects of alcoholic extracts of *Leptadenia reticulata* on induced breeding of Indian major carps, 7 sets of mrigal, 10 sets of rohu and 3 sets of catla were injected with ALR both in first and second dose and in combination with EMC, PG, EMOS, ECG, ACG, HCG or EDC as second dose. A separate PG control set was
also kept for each type. The alcoholic extract of *L. reticulata* failed to induce breeding in the major carps studied. Similarly all the aforementioned combinations with ALR did not show any positive response (Tables 16, 17, 18, 19, 20, 25, 26, 44, 45, 46, 64, 67, 68, 73) *L. reticulata* extracts have been shown to have anti-abortifacient action (Mangeshiker, 1957; Deshpande and Asher, 1952; Patel, 1965; Achari and Sinha, 1966). Present observations suggest that, may be because of its anti-abortifacient activity, ALR failed to create any positive response.

(vii) *Asparagus racemosa* Willd.

As reported earlier, the ethyl acetate and alcoholic extracts of the roots of *Asparagus racemosa* have been shown to induce uterine contraction in rat and rabbit (Jetmalani and Gaitonde, 1966). Further, Gaitonde and Jetmalani (1969a, b, 1970) showed the presence of antioxytocic activity in the alcoholic extracts of the roots and the presence of saponins which were found to block the spontaneous uterine motility. This prompted us to check the efficiency of the alcoholic extracts of the whole plant, *A. racemosa*, on the breeding pattern of the
major carps. Four sets of mrigal and 12 sets of rohu were administered with AAR or PG in first dose followed by AAR, oxytocin, PG, EMOS, EMOR, ECG, ALR, ACG, HCG, EDC or EMC in second dose. Present observations (Table nos. 25, 26, 41, 42, 43, 64, 67, 68 and 73) show no effect of AAR and various combinations on the breeding of the major carps, whereas the PG control sets showed either partial or full breeding. The failure of AAR might be due to the lack of uterine motility due to the presence of saponins as reported in case of rat rabbit and guinea pig (Gaitonde and Jetmalani 1969a, b, 1970).