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*Full Length Research Paper*

# Assessment of mung bean (*Vigna radiata* L.) as green manure in Aegean conditions in terms of soil nutriton under dıfferent sowıng dates

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**The experiment was conducted in Ege University, Faculty of Agriculture, Menemen Research, Application and Production Center during the years 2003 and 2004 to evaluate mung bean (variety ML-613) as a green manure under Randomized Complete Block Design considering three sowing times as three treatments in three replications. In this study, it was observed that the legume has a high biomass (2915 to 4405 kg/da) and grain yield (180 to 240 kg/da) in conditions of Aegean area. A short vegetation duration (60 to 75 days) was also recorded with high values of organic matter (70%), narrow C:N ratio (10) along with higher content of micro and macro elements. In this perspective, it was understood that mung bean is a convenient legume crop as green manure in Aegean conditions during summer.**

**Key words:** Mung bean, green manure, plant biomass, nutrients.

## INTRODUCTION

The crops used as green manure are generally turned into soil in order to improve the growth of subsequent crop. Ancient records from Greece and Southern Europe show that lupines and faba bean had been grown frequently in the Mediterranean region. To use the crops as green manure came into action much later but ever since the use of green manure, crops has declined because of the use of synthetic inorganic fertilizers (Mac and Mehuys, 1990). Nowadays, the concerns about sustainability of soil productivity and ecological stability, which come into view with the excessive use of synthetic fertilizers, have become prior. In this respect, use of legume crops as green manure to improve soil fertility and soil physical conditions has received increasing attention (Ladha et al., 1992; Whitbread et al., 2000; Ray and Gupta, 2001). The improvement in soil physical conditions as a result of build up of organic matter by incorporation of green manure or crop residue is associated with a decrease in bulk density, increase in total pore space, water stable aggregates and hydraulic conductivity of the soil (Tirlok et al., 1980 and Boparai et al., 1992) . Dhainca (*Sesbania aculeata)* and green gram or mung bean are some of the important legumes which are used as green manure. The legumes, which have a short vegetation duration and which are used as green manure show advantages in rice based cropping systems to sustain the productivity of the soil with their high adaptation capability and ability to fix the cavalier nitrogen (Buresh and De Datta, 1991; Yadvindcr et al., 1991; Dey and Jain, 2000; Bar et al., 2000). Besides the aquatic fern plant azolla (*Azolla anabaena*) which has drawn attention in the world as green manure on rice production due to the ability of rapid growing (Gevrek, 2000; Gevrek et al., 2004). Furthermore, the synthetic fertilizers are quite expensive and the essential amount to be applied is high.

For these reasons, more study is necessary to find out the better green manure crop suitable to our cropping system. With this objective the present trial was carried out to evaluate efficacy of the use of mung bean as green manure.

## M ATER IALS AND METH ODS

The present experiment was conducted during the years 2003 and 2004, in Menemen/ Đzmir. ML-613 variety of mung bean was sown in the plots in ten rows with 4 m lenght and the inter and intra row spaces were 60 and 15 cm, respectively to fit RCB design with three sowing time as three treatments in three

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**Table 1.** Sowing dates of trial in two different years (Menemen/Izmir, 2003 and 2004).

| Sowing date | Years | |
|---|---|---|
| | Menemen/ 2003 | Menemen/2004 |
| Z1 | 20.04 | 19.04 |
| Z2 | 20.05 | 20.05 |
| Z3 | 20.06 | 21.06 |

**Table2.** Main meteorological parameters of the experimental locations (Izmir/Menemen, 2003 and 2004)

| IZMIR 2003 | May | June | July | August | September | October |
|---|---|---|---|---|---|---|
| M Mean temperature ($^{O}$C) | 21.3 | 27.2 | 28.6 | 28.5 | 22.5 | 19.7 |
| N Number of rainy days | 5 | 1 | 0 | 0 | 0 | 8 |
| To Total rain (mm) | 8.5 | 0.8 | 0.0 | 0.0 | 0.0 | 68.5 |
| M Mean relative humidity | 52.5 | 37.5 | 37.3 | 38.2 | 46.9 | 51.8 |
| M Mean insolation duration (h) | 9.0 | 11.8 | 12.3 | 11.1 | 9.2 | 6.8 |
| **IZMIR 2004** | | | | | | |
| M Mean highest temperature ($^{O}$C) | 27.0 | 32.9 | 35.6 | 34.6 | 30.8 | 27.4 |
| M Mean lowest temperature ($^{O}$C) | 12.7 | 18.3 | 21.4 | 20.8 | 17.4 | 13.5 |
| Mean temperature ($^{O}$C) | 20.3 | 26.5 | 29.0 | 27.8 | 23.8 | 19.8 |
| N Number of rainy days | 5 | 2 | 1 | 0 | 0 | 3 |
| To Total rain (mm) | 10.7 | 1.6 | 1.8 | 0.0 | 0.0 | 1.6 |
| M Mean relative humidity | 48.4 | 45.1 | 37.3 | 45.6 | 49.0 | 54.2 |
| M Mean insolation duration (hours) | 8.8 | 10.4 | 12.0 | 10.3 | 9.1 | 7.5 |

**Table 3.** Soil properties of experimental field (Izmir/Menemen, 2003 and 2004).

| | 2003 | | 2004 | |
|---|---|---|---|---|
| | Surface | 30 cm | Surface | 30 cm |
| Sand (%) | 22.3 | 25 | 22 | 24 |
| Clay (%) | 41 | 36.3 | 41 | 35 |
| Silt (%) | 44.2 | 40 | 45 | 40 |
| Structure | Silt-clay | Silt-clay | Silt-clay | Silt-clay |
| pH | 7.5 | 7.5 | 7.5 | 7.5 |
| CaCO3 | 11.86 | 13.0 | 12.0 | 13.26 |
| N (g) | 0.12 | 0.09 | 0.10 | 0.8 |
| P ppm) | 4.306 | 5.036 | 4.001 | 5.540 |
| K | 0.67 | 0.403 | 0.55 | 0.34 |
| Salt | 0.81 | 0.076 | 0.901 | 0.103 |
| Organic matter | 6 | 4 | 5 | 4 |

replications for the evaluation of mung bean as a green manure. Sowing was done manually. Sprinkler irrigation was applied at the different sowing times twice during vegetation, once at sowing and once before flowering. Nitrogen ($NH_4$) and phosphorus ($P_2O_5$ ) were applied at a rate of 23 and 60 kg/ha respectively prior to sowing. Seeds were sown in three seperate dates at one month interval from 3rd week of April on both the year of experiment.

Sowing dates can be observed at Table 1. The environmental conditions during the experiment are shown at Table 2 and the soil properties of experimental sites are shown at Table 3.

Fresh plant yield for one plant (leaf, branch and root) was determined from randomly chosen plants at early flowering stage taken from each parcel of different sowing times. Same plant samples were dried at 65˚C and the dry matter (leaf, branch, root), organic matter and C/N ratio was derived for every different sowing time. 1500 plants per da are approximately advised in literatures. Multiplied the fresh plant weight for one plant sample by 1500, the fresh plant yield for every parcel was calculated (Table 4). The dry weight amount for da was calculated by the fresh weight amount multiplying by dry weight ratio and the organic matter for per da was calculated organic material ratio

**Table 4.** The mean values of dry and fresh matter, organic matter and C/N ratio on different sowing days (Menemen/Izmir, 2003 and 2004).

| | Sowing date | Fresh matter weight | | Dry matter weight (65˚C) | | Organic matter ratio | Amount of organic matter Kg/da | C/N |
|---|---|---|---|---|---|---|---|---|
| | | Yield of one plant(g) | Yield (kg/da) | Dry matter ratio | Yield (kg/da) | | | |
| Leaf | Z1 | 113.3 | 1700.0 c | 16.5 | 280.0 | 70.0 | 196.0 | 10.0 |
| “ | Z2 | 160.0 | 2375.0 b | 17.0 | 403.7 | 70.0 | 282.0 | 10.0 |
| “ | Z3 | 189.0 | 2835.0 a | 17.0 | 482.0 | 70.0 | 337.0 | 10.0 |
| Mean | | 154.0 | 2303.0 | 16.8 | 388.0 | 70.0 | 271.0 | 10.0 |
| Branch | Z1 | 66.0 | 990.0 | 17.0 | 168.0 | 70.6 | 117.6 | 25.0 |
| “ | Z2 | 85.0 | 1267.0 | 18.0 | 228.0 | 71.0 | 161.8 | 26.0 |
| “ | Z3 | 96.0 | 1440.0 | 18.0 | 259.0 | 71.0 | 183.0 | 27.0 |
| Mean | | 82.3 | 1232.3 | 17.6 | 218.0 | 70.8 | 154.1 | 26.0 |
| Root | Z1 | 15.0 | 225.0 a | 18.0 | 40.5 | - | - | - |
| “ | Z2 | 11,5 | 172.0 b | 18.0 | 30.9 | - | - | - |
| “ | Z3 | 8.7 | 130.0 c | 18.0 | 23.4 | - | - | - |
| Mean | | 11.7 | 175.6 | 18.0 | 31.6 | - | - | - |
| Total amount | Z1 | 194.0 | 291.5 | - | 488.0 | - | 313.6 | - |
| Total amount | Z2 | 256.5 | 3814.0 | - | 662.6 | - | 443.8 | - |
| Total amount | Z3 | 300.0 | 4405.0 | - | 764.4 | - | 520.0 | - |

Fresh weight yield (kg/da): Leaf : LSD (5%):89.4, CV:3.09; Branch: year x sowing date 10.42 $^{xx}$, CV:3.61; Root: LSD (5%): 24.0, CV:10.88.

**Table 5.** One plant fresh yield and the mean values of yield characteristics (Menemen/Izmir, 2003 and 2004).

| Sowing date | Fresh yield (one plant) (g) | Bunch number on plant (number/plant) | Number of legumes (number/plant) | 1000-grain weight (g) | Legume yield (g/plant) | Legume yield (kg/da) | Flowering duration days |
|---|---|---|---|---|---|---|---|
| Z1 | 194.0 | 4.7 | 187 | 25 | 12 | 180 | 75 |
| Z2 | 256.0 | 6.0 | 210 | 24 | 14 | 210 | 68 |
| Z3 | 300.0 | 8.3 | 230 | 24 | 16 | 240 | 60 |

multiplied by dry matter, The values for leaf, branch and root of different sowing dates were added and the total values were calculated (Table 4).

The number of bunches (number/plant), legumes, (number/plant) grain yield (g/plant) for one plant and the weight of thousand grains (g) were determined before the fruit layers opened but when the leaves become yellow on the randomly chosen ten plants. The grain yield for per da (kg/da) was calculated by multiplying the grain yield for one plant by 1500. Flowering duration (days) was determined as the spell between sowing date and 50% flowering date (Tables 4 and 5).

The amount of macro and micro elements on leaves and branches was determined from the material dried at 65˚C for the flowering date Z3 which was the prior on fresh weight per da, statistically (a) (Tables 4 and 5).

The value of raw protein (kg/da) was calculated by multiplying the amount of dry matter content leaves and branches (kg/da) by N% of the third sowing date's (Z3) dry matter which has the first place statically (a) and by 1.7.

## RESULTS AND DĐSCUSSĐON

The mean data of two years on fresh yield of stem, leaves and root are shown in Table 4. The fresh weight of leaves for per da varied between 1700 and 2835 kg/da, thus the mean yield was 2303 kg/da. The highest value of yield was obtained from the third sowing date (Z3) as 2835 kg/da (Table 4). The fresh weight value of branch and stem for per da is between 990 and 1440 kg and the mean yield was 1232.3 kg/da. The highest yield was obtained from the third sowing date as 1440 kg (Table 4). The fresh weigt of root varied between 172 and 225 kg/da and the highest value was recorded under the first sowing date (Z1) as 225 kg/da. The highest biomass for per da was obtained from the 3rd sowing date and the value was 4405 kg/da (Table 4) .

The dry matter recovery varied between 16.5 and 18 and the mean ratio for leaf, branch-stem and root at three different sowing dates were 16.8, 17.6 and 18 respectively.

The dry matter yield of leaf, stem-branch and root on three different sowing dates at leaves was between 280 and 482 kg/da, the mean value was 388 kg/da as seen on Table 4. The highest total dry matter (764.4 kg per da)

**Table 6.** The dry matter yield, % N and raw protein yield of third sowing date, from which the highest dry matter yield is obtained (Menemen/Izmir, 2003 and 2004).

| | | Dry matter weight (kg/da) | N (%) | Raw protein yield * (kg/da) |
|---|---|---|---|---|
| Leaf | Z3 | 482.0 | 3.2 | 262.2 |
| Branch | Z3 | 259.0 | 1.7 | 74.8 |
| Total amount | | 741.0 | | 348.5 |

*: Dry matter x N % x 1.7.

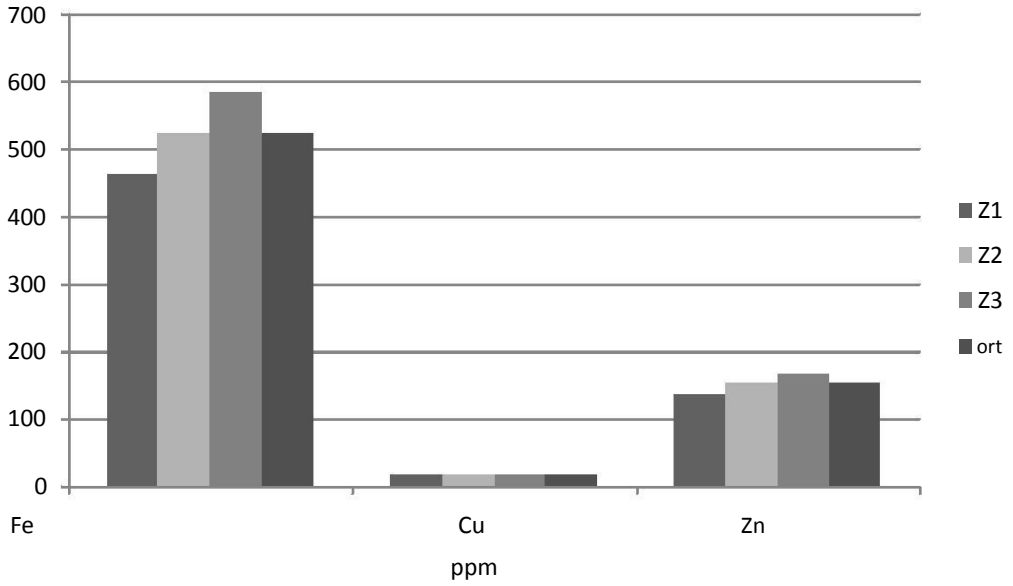


**Figure 1.** Different amount of micro elements on leaves on different sowing dates.

per da was observed from third sowing date (Z3).

The mean organic matter ratio on leaves was acquired 70, it was on branch- stem 70.8 as seen on Table 4. The organic matter value on leaves was found between 196 and 337 and the mean organic matter obtained from three different sowing dates was 271 kg/da. The organic matter on stem-branch varied between 117 and 183 kg per da and the mean value for three different sowing dates is 154.1 kg. The highest mean organic matter value was obtained from the third sowing date (Z3) as 520 kg. (Table 4).The mean C:N ratio on leaf and stem-branch was 10 and 26 respectively.

If we go through Table 5 we can see that the highest values of fresh weight for one plant (300 g/plant), the bunch number per plant (8.3 number/plant), legume number (16 number/plant), legume yield (240 g/plant), were obtained on third sowing date. The highest value for thousand grain weight (25 g) was obtained at the first sowing date. Flowering date for three different sowing dates varied between 60 and 75 days after sowing, The shortest flowering duration was at the third sowing date with 60 days and the longest flowering duration was at the first sowing date with 75 days.

On Table 6 can be seen that the N% and raw protein yield (kg/da) of third sowing date, from which the highest dry matter values of leaf and branch-stem were obtained. The dry matter on leaf and branch-stem was 482 and 259 kg/da respectively on the third sowing date, the total dry matter obtained from leaves, branch-stem was 741 kg for per da. The N% values was obtained as 3.2 and 1.7 on leaves and branch-stem, respectively. The raw protein amount purchased from leaves and branch-stem was 348.5 kg.

The mean values of macro and micro elements of the leaves and branch-stem which was harvested on flowering time of different sowing dates during the years 2003-2004 can be seen on graphical representation (Figures 1, 2, 3 and 4). It can be observed that at different sowing dates the amounts of N, Mg, and Ca%, Fe, Cu and Zn (ppm) were increased in parallel to later sowing dates (Figures 1 and 2). On the amounts of P and K% no differences were detected. The values of N, P, Mg, and Ca% and Cu (ppm) for branch-stem were increased in parallel to later sowing dates. There was no difference detected on the values of K%, Fe and Zn (ppm) (Figures 3 and 4). When the macro and micro

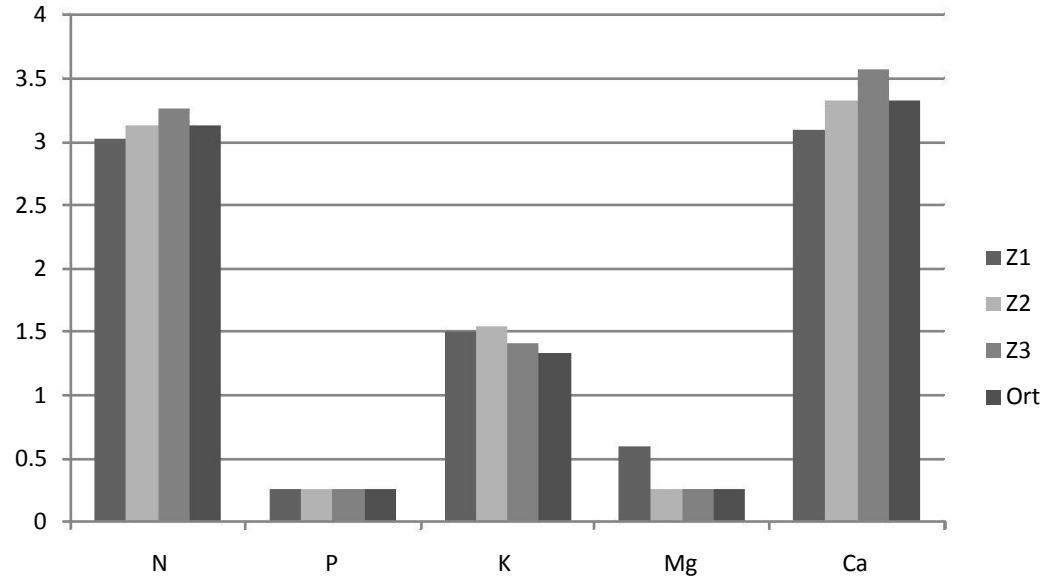


**Figure 2.** Different amount of macro elements on leaves on different sowing dates.

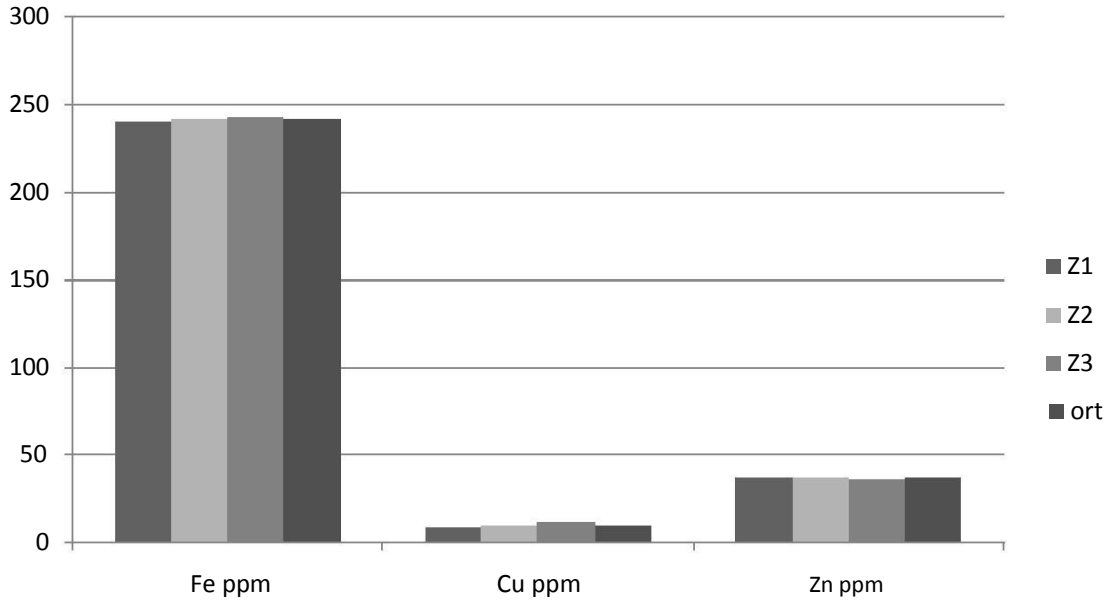


**Figure 3.** Different amount of micro elements on stem-branch on different sowing dates.

elements on leaf and branch-stem, which were analysed according to three different sowing times, are compared, the K% ratio was found higher than leaf on branch-stem and the values of the other elements were lower in leaves than branch-stem as seen on Figures 1, 2, 3 and 4.

## Conclusion

In the process of the trial, which was conducted during the years 2003 and 2004 in three different sowing dates from 20$^{th}$ of April every 20 days, the highest fresh weight, dry matter and organic matter was obtained from the third sowing date as 4405.0, 764.0 and 520.0 kg/da, respectively. The half of the biomass obtained from one unit area belongs to the leaves and C:N ratio as 10, it is understood that the mung bean can easily be mineralized when it is turned into the soil. The short flowering duration (60 to 75 days) of mung bean shows that it can leave the field in short period for a subsequent crop. Some wanted characteristics for green manure crops are low

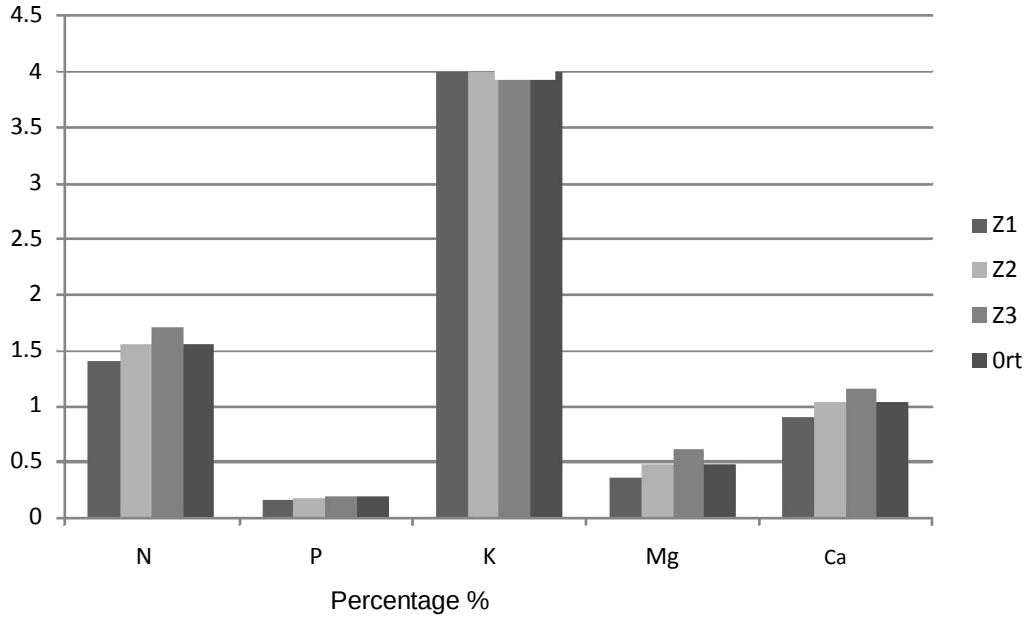


**Figure 4.** Different amount of macro elements on leaves on different sowing dates.

thousand grain weight and high grain yield. The thousand grain weight of mung bean as between 24-25 g and the grain yield as 180-240 kg/da are favorable for choosing the plant as green manure. That the protein yield reaches the values of 348.5 kg/da, when the legume is used in maize silage, can be expected to improve the silage protein value. Especially the high values of macro and micro elements on leaves can increase the importance of mung bean as green manure. The low 1000 grain weight, high grain yield and wealthy values of minerals can be expected as a positive answer for the search of legumes with high nutrients.

In conclusion, it is understood that early flowering mung bean varieties can be a positive answer for the search of summer grown green manure especially before rice production in second crop conditions, like the aquatic floating fern plant Azolla (*A. anabaena*) and the aquatic legume dhainca (*S. aculeata*) with short vegetation duration, high biomass and organic matter, narrow C: N ratio besides high values of macro and micro elements.

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