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ENERGY BALANCE OF SUNFLOWER CULTIVATION IN S.S.R. MOLDOVA

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SUMMARY

The problem of reasonable use of energy in modern production, particularly in agriculture, is still of vital importance. Just this circumstance makes us concider the technology of cultivation of sunflower from the point of view of effectiveness /recoupment/ of productive energy expeditures, accumulated in the harvested yield.

In our view, this is a more stable index than the economic one, because of the flexibility of prices for material resources and the economic system typical for our days.

A more exhaustive analysis has shown that there are real possibilities of reducing the energy expenditures for the technology of tillage. For instance, in the block of main preparation of soil–by 6.9%, fertilizers–by 7.2, pesticides–by 4.7% etc. Another considerable reserve for improvement of energy balance of production is the increase of energy accumulated volume owing to increase of sunflower yield.

Key words: Energy input, sunflower, effectiveness.

INTRODUCTION

The rationalization of energy expenditures in modern production of agricultural produce is a topical problem for those countries which have achieved a high (or good) crop capacity. Thus, the energy expenditures for production of 1 ton of maize have increased more than three time (Evdokimov, 1984), but with a gradual increase of price of energy, the cost of power inputs for production of maize and winter crops has increased 6–6.5 times, for soybeans 7.5 times. Naturally, the energy capacity of plant–growing production, to a great extent, depends on the provision of this or that crop with ecological resources. Thus, the production of 1 ton of sunflower in the northern zone needed 1.2–1.3 times less energy consumption than in the southern zone of S.S.R. Moldova, while in the "corn belt" of the USA for 1 ton of maize it was necessary to spend 2.2 times less energy. Then, for example, in Texas, in Kanzas and Colorado, for 1 ton of wheat grains 4.0–5.7 times less energy is needed than in Arizona.

In S.S.R. Moldova in 1986–1990 the level of crop capacity of sunflower was 2.0–2.1 t/ha, stable rates in the increase of crop capacity (0.31 c/ha/year) were noted in the period after the years of 1980–1981, when practically at the same time we switched over to the cultivation of this crop, in which abrutly the energy consumption for pesticides, fertilizers and CCM has increased. In this case the volume of energy consumption has risen from 25.2 to 32.5 thousand Mdg., and the volume of accumulated energy from 30.2 to 44.5–48.1 1 ha area under the crop. The energy coefficient has changed from 1.1 to 1.42. The given data (Vronskih, 1986) show that this quantity while cultivating sunflower is considerably lower than that for winter wheat (2.2), or maize (2.0) and only slightly

higher than the quantity for soybeans (1.2–1.4), (Juchenko, Ursu, 198).

This proves once again the great significance of a search for reserves to optimize the energy balance of production of sunflower oil raw–materials.

MATERIAL AND METHODS

In this paper there are statistical materials concerning the crop capacity of sunflower in Moldova in the years 1850–1990, and also the results of field and production experiments, of new variants of technology or of separate blocks of this technology, carried out at the Institute or at experimental farms.

The norms of energy expenditure and balance calculations were carried out according to methods of VIM (Moscow, 1986).

RESULTS AND DISCUSSION

Calculations of energy balance of production of oil raw materials obtained from sunflower have proved that the total consumption of energy per 1 ha of sown area while switching over to an intensive variant of technology has considerably increased (by 28.9%), and this fact confirms the tendencies noted in the cultivation of other crops.

Due to that the structure of energy consumption has also changed in comparison with the traditional technology (Figure 1,2), and also considerable deviations from the structure of cost price of production have been marked, and this is the result of inadequate correlation between the prices on material resources and the volume of energy spent on their production (Figure 3). A more exhaustive analysis shows that the sum of energy spent on the preparation of soil, use of mineral fertilizers, particularly nitrogen, pesticides (primarily herbicides) etc., is very high.

New tendecies of technological improvement can be evaluated (save for agrobiological and economic ones) also according to the energy criterion.

Thus, the replacement of mould-board ploughing with a more progressive method (non–mould ploughing) without reduction of productivity of oil–seeds offers possibility to reduce energy consumption by 6.9% in comparison with the main variant.

The reduction of nitrogen fertilizers from 50 to 60 t/ha (after D.V.) also allows to economize almost 2.0 thousand MDg (7.2%) of energy, thus preserving the optimum (favourable) correlation between the yield of seeds and leaf–caulescent mass.

The utilization of more progressive methods (belt, local) of introduction of herbicides, simultaneously alleviating the problem of environment protection, permits us to reduce the expenditure for pesticides by 4.7% and, of course, to reduce the energy consumption by 1.3 thous. Mdg. per 1 ha. To the reduction of energy consumption for weed control a great contribution was made by the use of more efficient assortment of preparations (for instance, for introduction on vegetative plants of sunflower) which permitted us to use them more effectively only on the plantations where the weededness is higher than ELO. However at present there are no effective herbicides against dicotyledonous weeds and this hampers the use of this method in zones with mixed type of weededness. Another method of reducing the volume of herbicides is the heightening of sunflower competiveness against weeds. For example, this can be achieved by narrow-

THE PATTERN OF ENERGY EXPENDITURE AND COST PRICE OF SUNFLOWER PRODUCTION

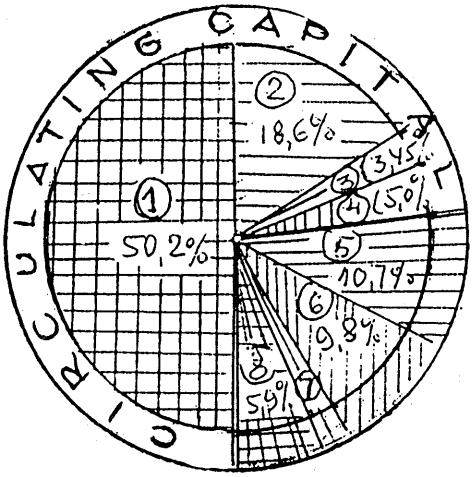

Figure 1 Traditional technology (= 25.2 thousand MJ)

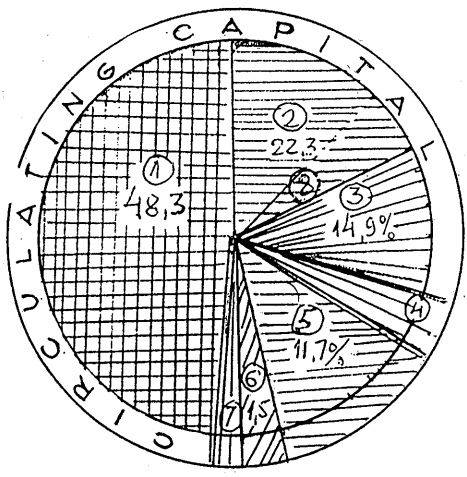

Figure 2 Intensive technology (= 32.5 thousand MJ)

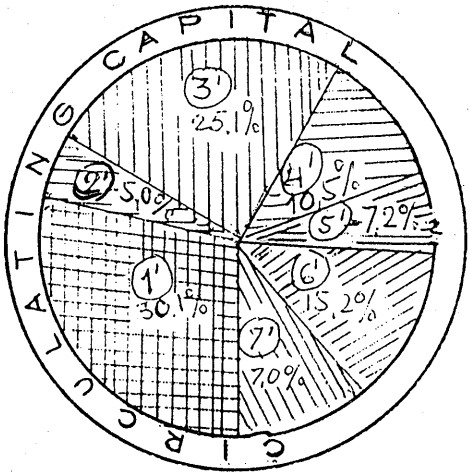

Figure 3 Pattern of cost price by sunflower production

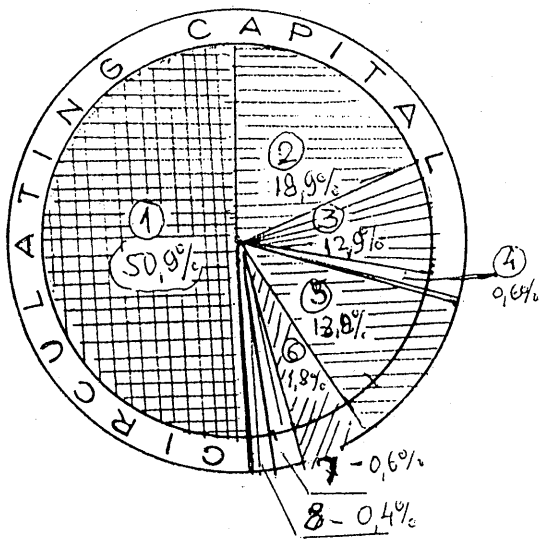

Figure 4 Improved intensive technology (= 27.7 thousand MJ)

CONVENTIONAL SIGNS:

for Figure 1,2,4: 1 – fuel and lubricant; 2 – fertilizer; 3 – pesticides; 4,8 – other; 5 – machinery; 6 – manpower; 7 – agricultural;

for Figure 3; 1'– machinery; 2'– seed; 3'– manpower; 4'– others; 5'– pesticides; 6'– fertilizer; 7'– fuel and lubricant

ing the width between the rows (from 70 to 45 cm), during sowing in the last optimum term.

In this case the sunflower leaves cover altogether the space between the rows 9–12 days earlier than usual, thus protecting the space from sunbeams. In the struggle against the monocotyledonous weeds, the herbicides on vegetative plant parts are used.

Table 1. The structure of energy consumption in the production of sunflower

Index	Traditional technology	Intensive technology	Improved intensive technology
Yield c/ha	17.0	25.0–27.0	26.0–27.0
Energy accumulated by the yield (thous.Mdg)	30.2	44.5–48.1	44.5–48.1
Consumed energy, thous. Mdg	24.6–27.5	32.6–33.1	27.7
Includ: amortiz.agric.machines and equipment, Mdg–%	2730–10.7	3826–11.7	3824–13.8
Cultivation of soil	837.6–3.3	837.0–2.6	790–2.85
Introduction of fertilizers	162.4–0.7	162.4–0.5	159–0.6
Harversting	1225.8–4.8	1215–3.7	1257–4.6
Other (including the introduction of pesticides)	1100–4.4	1600.4–4.9	1600–5.8
Includ. agric. aircraft	182.0–0.8	182.0–0.6	182–0.65
Circulating assets	18613–72.6	28094–86.2	23092–83.4
Fertilizers, total	4752–18.6	7229–22.3	5229–18.9
N	2830–11.1	5308–16.3	3308–4.9
P	1424–5.6	1423–4.3	14.24–5.1
K	438–1.9	498–1.5	498–1.8
Pesticides	880–3.45	4888–14.9	3587–12.9
Fuel	12801–50.2	15769–48.3	14101–50.9
Electricity	180–0.7	174–0.5	175–0.6
Labour resource (manpower resourses)	2490–9.8	491–1.5	498–1.8
Mechanical labour	503–2.0	334–1.0	356–1.3
Other	1520–5.9	–	100–0.4

CONCLUSIONS

The modern technology of tillage for sunflower presupposes a great volume of energy consumption per 1 ha of area sown or for 1 ton of production.

The main directions of optimizing the energy consumption in sunflower production are as follows.

– The replacement of mould-board ploughing method with non–mould–board methods for the preparation of soil.

– Optimization of mineral fertilizer doses introduced in the soil, primarily nitrogen.

– Reduction of pesticides use, especially of herbicides, through the introduction of more advanced methods (such as belt and local), or through the utilization of better assotment of preparations (herbicides, suitable for the use on vegetative plants of sunflower, etc.).

The realization of these and other possibilies facilitates the reduction of energy volume to 27.7 thousand Mdg, (17.3%) per 1 ha of sown area, and it also helps to get the coefficient of effectiveness (1.61–1.73), which is fully comparable with the indices for other field crops.

BALANCE ENERGETICO EN EL CULTIVO DE GIRASOL EN S.S.R. MOLDOVO

RESUMEN

El problema de un uso razonable de la energía en la producción moderna particularmente en agricultura es aún de vital importancia. Justamente esta circunstancia nos hace considerar la tecnología de cultivo del girasol desde el punto de vista de la efectividad del gasto de energía, acumulado en el rendimiento recolectado.

Desde nuestro punto de vista, este es un índice mas estable que el económico, debido a la flexibilidad de precios para recursos materiales y para el sistema de pago típico de nuestros días.

Un análisis mas exhaustivo ha mostrado que hay posibilidades reales de reducir los gastos de energín en la tecnología de labores. Por ejemplo en el bloque de la preparación del suelo por 6.9% de fertilizantes, 7.2%, pesticidas 4.7% etc. Otra considerable reserva para la mejora del balance de energía de producción es el íncremento del volumen de energía acumulada debida al incremento del rendimiento de girasol.

BILAN ÉNERGÉTIQUE DE LA CULTURE DE TOURNESOL EN RÉPUBLIQUE SOCIALISTE DE MOLDAVIE.

RÉSUMÉ:

Le probléme de l'utilisation raisonnée de l'énergie dans la production moderne et particulièrement dans l'agriculture, est encore d'une importance vitale. Cette constation nous a amené à considérer la technique de culture du tournesol sous l'angle de l'efficacité des dépenses d'énergie de production cumulée par rapport au rendement récolté.

Nous pensons que cet index est plus stable que l'index économique du fait de la variation du prix des ressources en matériel et pour le systéme de paiement en cours de nos jours.

Une analyse plus complète a montré qu'il existe une réelle possibilité de réduire les dépenses énergétiques suivant les techniques de labour. Un autre potentiel considérable pour l'amélioration du bilan énergétique de production passe par l'augmentation de l'énergie cumulée dans le rendement en optimisant ce dernier.