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**RESULTS OF OPTIMIZATION OF ASSEMBLY COMPOSITION FOR
CHEMICAL PROTECTION OF PLANTS WITH DYNAMIC BATCHERS**

Ju.S.Tsukanov, Cand.Tech.Sci., I. V.Gorbenko, the engineer

The Odessa State Agrarian University

The technique of optimization of assembly composition for chemicals application on production engineering of operated farming is developed.

Key words: the batcher, farming, poison, the spraying machine, production engineering.

Introduction. Now the advanced enterprises of Ukraine have possibility to buy modern technics for protection of plants that intended for operated farming. But the domestic technics has no dynamic batchers for operated farming.

Problem. Economic conditions of the majority farms do not allow to get new technics for protection of plants which costs much. Domestic spraying machines with the dynamic batchers installed on them have an advantages. Therefore at the introduction in manufacture of new production engineering of the mechanised works it is cheaper to use domestic tractors and cars, to instal on them the additional equipment for operated farming and automatic traffic across the field. It considerably reduces the cost price of works and products.

The analysis of last researches and publications. World practice testifies that any of existing methods does not give a full assurance of protection of plants though each of them was oriented the utter annihilation of harmful installations at its application. Even the chemical method of strong poisons use provides a maximum of 99 % destruction of harmful organisms. Eggs, dolls and larvae of insects which are in plants, practically are not annihilated that leads to emersion of new harmful installations of environmental contamination and needs repetition of protective provisions. The exterminatory concept provided processing of crops with pesticides with the appearance of the first harmful installations irrespective of their quantity and sizes of expected harm, and more often for the purpose of preventive maintenance. Therefore the integrated method became alternative to the concept. The integrated method consists in a harmonious union of all methods. It is based on complex use of all expedient preventive and annihilative methods, their system analysis, forecasting of harmful installations development and their harmfulness level according to the account of many factors, i.e. on system of monitoring (observation) over each concrete field. Not utter annihilation of harmful installations, but only regulating of quantity of harmful and useful aspects is an ultimate goal of the integrated method. The so-called harmfulness threshold (such quantity of harmful installations on 1m² of a field surface which injures a crop much more, than expenses for prevention of these losses) is a criterion of protective measures application. For plants to have the modern integrated protection of plants against sicknesses, pests and harmful plants it is necessary to have the equipment for dynamic regulating of

pesticides application rate which is not present on the majority spraying machines. Steps of dynamic batchers introduction at protection of plants in manufacture can be following:

- Revealing of quantities and weeds species composition correlation with their position in the field;
- Formulation of cartograms of herbicides application rate depending on weeds location;
- Working out of the program of management by the batcher of the spraying machine with dynamic regulating of herbicides dose;

- Working out the implementation plan of herbicides application cartogram;
- Revealing of correlation of quantities and species composition of sicknesses and pests with their location in the field;
- Formulation of cartograms of herbicides application rate depending on their location;
- Working out of the control program by the batcher of the spraying machine with dynamic regulating of an insecticides dose;

- Working out the implementation plan of insecticides application cartogram .

In modern domestic spraying machines a wide unification of working and subsidiary organs and assembly unit which has the international character is provided. It concerns mainly hydraulic communications: pumps, atomizers, armatures, controls. For the complete equipment of domestic cars the accessories of leading foreign firms are used. The spraying machine of series OPW-2000 which is produced in seven designs modifications, and for blower sprayers - OPW-2000 is a base model of domestic serial spraying machines. The spraying machines OPW-15-03, OP-2000-01, OM-630-2, OM-320-2, with ventilating fans - OPB-1200-01, OYM-4, OM-630, OM-320, etc. are also operated. From researches [1,2,3] it is known that serial spraying machines for operated farming will be equipped with GPS navigators, the equipment for dynamic regulating of chemicals application doses, the tractor is rigged by the satellite navigator. Spraying is carried out without foam markers. The accuracy and speed of spraying and the possibility of spraying at night time is enhanced. For profit increase it is necessary to use fuel as much as possible effectively which is possible to provide by the use at spraying of parallel driving system Parallel Tracking and systems of automatic driving AutoTrac. Systems work at use of signal SF1 (accuracy of driving ± 30 cm), subscriber's signal SF2 (accuracy of driving ± 10 cm) or signal RTK with accuracy ± 2 cm. At use of system Parallel Tracking it is necessary for operator to lead the unit on a track shown on the display. System Parallel Tracking allows to move across the field, collecting data about composition of weeds, sicknesses and pests, pesticides application. Systems AutoTrac allows to work in an automatic regime. The operator should take a rudder only at the turns at the end of the rut or with bypass obstacles . Besides speed of taking bends at the end of the rut increases as AutoTrac automatically computes a path of the next pass. At system AutoTrac use the areas of mutual overlapping reduce at the expense of smaller quantity of passes, productivity increases at the expense of the exact entering of chemicals, all working width of the equipment is used, working

speeds increase. Systems of operated farming use the hardware which includes three components for work with any applied software. For example system GreenStar John Deere hardware consists of the mobile processor, position antenna StarFire and display GreenStar which make the integrated system which can be used on other technics. These three components are easily reinstalled with domestic tractors and combines, spraying machines and other technics. The other key element of system are signals GPS which help to define co-ordinates . The software is delivered on card Keycard. It is possibly in addition to use flash card DataCard on which all information of productivity map-making remains. Advantages of automatic traffic across the field are that the minimum area of mutual overlappings even in the conditions of low visibility, there is a possibility of use of all working width of the rod, average speed of traffic increases, consolidation of a ground decreases at the expense of smaller quantity of the passes, the level of the tractor operator comfort is raised.

The purpose of researches. After the analysis of trailer and self-moving spraying machines design, studying of agrotechnical and economic aspects of process of chemicals entering poisons, we set as the purpose to define optimum composition of machine - tractor unit for implementation of dynamic batchers in operations of plants protection in plant growing. The purpose is to reveal tractors brands and machines of plants protection which will be most convenient for conditional farms of the different areas and meet agrotechnical demands. Two farms are chosen as conditional ones: a total area - 1500 and 4000 hectares.

Results of researches. At definition of technique composition we choose domestic tractors for spraying which can be connected with a universal complete set for automatic driving (UCAD) firm "John Deere": UMZ -8040.2, UMZ -8244.2 class 14KH., hardware of system GreenStar John Deere (the mobile processor, position antenna StarFire and display GreenStar, card KeyCard and DataCard,) .At the second stage we choose spraying machines, the equipment for a dynamic dosage and the software: spraying machines OPW-2000, Orlan-24 and OPK-3000-24; the satellite navigator „Skipper”, the block of computer control and automatic control of the application rate of pesticides, Bravo-300S, pump Annovi-135, benchboard Arag, a complete set of injectors Leachier; the software of the Isochapellet). At the third stage we use the program for definition of optimum composition of the machine-tractor unit with the equipment for a dynamic chemicals dosage and automatic traffic across the field we use such mathematical model. In the capacity of an optimization we accept a minimum of a factor cost for of the mechanized works conducting. The structural economy - mathematical model for production engineering optimisation has such appearance. In model the accepted designations are: i - an index of tractors and machines; j - an index of works; k - an assembly index; t - an index of the period of work performance ; X_i - quantity of tractors and machines i brand; X_{kjt} - quantity of assemblies with number k , necessary for performance j - work in t -m period; A_{kjt} - productivity of k th assembly executing j - work in t - m period; P_{jt} - volume j - work in t -m the period; B_{ikj} - quantity of tractors and machines of i - brand, which enter in k - assembly executing j - work; C_{kjt} - direct operating costs for performance j - work by k -m assembly in t -m period; C_i - balance cost of i - machines, K_{in} - factor of

inflationary expectation of exchange rate, a - standard effectiveness ratio of capital investments; M - number of tractors and machines; N - number of the executed agricultural works; N_t - number of the works executed in t -m period; I - numbers of machines - tractor assemblies; L_j - number of machines - tractor assemblies executing j - work; T - number of settlement agro technical due dates of works execution. The purpose of calculations: to find such composition of assemblies for protection of plants and production engineering of the mechanised works at which there is a minimum of the resulted losses on performance of the set amounts of works:

$$\sum_{t \in T} \sum_{j \in N} C_{kjt} * K_{iH} * X_{kjt} + a * \sum_{i \in M} C_i X_i \rightarrow \text{MIN} \quad (1)$$

At performance of restrictions: 1) on performance of all works in the set optimum agrotechnical terms:

$$\sum_{k \in C} a_{kjt} * X_{kjt} = P_{jt}, \quad (i \in N, t \in T); \quad (2)$$

Conclusions. Results of composition optimization of plant protection units with dynamic batchers for performance of the mechanised works in farms: - The area of 1500 hectares: assembly UMZ-8040.2+Orlan-24 with the software and the satellite navigator „Skipper”, the block of computer control and automatic control of the application rate of pesticides Bravo-300S, pump Annovi-135, benchboard Arag, a complete set of injectors Lechier, (a minimum of a factor cost - 386,06 thousand uan. And annual amount of works 9000ha).- The square of 4000 hectares assembly UMZ-8244.2+OPK-3000-24 with the software and the satellite navigator „Skipper”, the block of computer control and automatic norm control of entering poisons Bravo-300S, pump Annovi-135, benchboard Arag, a complete set of injectors Lechier, + system parallel driving Parallel Tracking (a minimum of a factor cost - 984,11 thousand uan and annual amount of works 16000ha).

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РЕЗУЛЬТАТИ ОПТИМІЗАЦІЇ СОСТАВА АГРЕГАТА ДЛЯ ХІМІЧЕСЬКОЇ ЗАЩИТИ РАСТЕНИЙ С ДИНАМІЧЕСКИМИ ДОЗАТОРАМИ

Цуканов Ю.С., Горбенко І.В.

Ключевые слова: дозатор, земледелие, опрыскиватель, технология, яд.

Резюме

Разработана методика оптимизации состава агрегата для защиты растений с динамическим дозатором.

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J.S.Tsukanov, I.V. Horbenko

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Sammary

The technique of optimization of the assembly composition for protection of plants with the dynamic batcher is developed.