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# Accumulating Soil Nitrogen

By

## Manure and Cover Crops

Departments of Agronomy and Horticulture



With commercial nitrogen scarce, cover and green manure crops are more important than ever before.

UNIVERSITY OF MARYLAND  
EXTENSION SERVICE  
College Park, Md.

## SUMMARY OF RECOMMENDATIONS

1. Use superphosphate in stable gutters and on dropping boards to prevent loss of nitrogen from manure and to balance its plant nutrients.
2. Spread manure and disk in or plow under as soon as possible.
3. Keep manure moist and tightly packed until it can be spread.
4. When row crops follow immediately, plow under any non-legume while it is young and tender. Otherwise, soil nitrogen will be drawn upon temporarily for its decomposition.
5. Legume seed costs are in line with crop returns. Planting legumes wherever possible is an economy particularly while commercial nitrogen supplies are inadequate.
6. Use adapted varieties or strains.
7. Inoculation is cheap; use it.
8. Fertilize legumes liberally with phosphorus and potash.
9. Prepare firm seed bed to insure stand of clovers and other small seeded plants.
10. In crop rotations, use legumes in the grass fields that will persist until the land is plowed.
11. Buy legume seed early and plant as nearly the recommended time as possible.
12. Cover crops wisely chosen for use in orchards can overcome the need for much commercial nitrogen.

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FOREWORD

SYSTEMS of farm management which provide for saving and returning to the soil a large percentage of the fertility removed in crops, for protecting the soil by cover crops, and for obtaining as much as possible of the soil nitrogen from the air are economical at all times.

Under present conditions, immense quantities of nitrogen are being used in the manufacture of war explosives and the supply of commercial nitrogen available for agricultural uses is limited. It is imperative that producers of farm crops exercise every precaution in saving their nitrogen supply and give greater attention than ever before to obtaining nitrogen from other than commercial sources.

In this publication, the departments of Agronomy and Horticulture of the University of Maryland give recommendations and information regarding methods that will assist Maryland producers in maintaining their soil nitrogen. It is designed to help them meet the demand for record production in the war program, despite the limitation on commercial nitrogen.

T. B. SYMONS, *Director*

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T. B. SYMONS, Director.

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# ACCUMULATING SOIL NITROGEN

By

## USE OF MANURE AND COVER CROPS

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Departments of Agronomy and Horticulture

MARYLAND farmers used between 5,000 and 6,000 tons of nitrogen in commercial fertilizers in 1941. During the coming year much less commercial nitrogen will be available to them because of the large quantities consumed in the manufacture of war explosives. The total supply of nitrogen normally used in commercial fertilizers is smaller than that which is obtained either directly from the atmosphere by use of legumes or in manure from farm herds and flocks. However, the limited quantities applied in fertilizers are used at the times and in the places where they are peculiarly needed for most profitable crop production.

With shortage of commercial nitrogen for the coming year it is necessary to make greater and more judicious use of manures and legumes than ever before if crop production is to be maintained. This publication includes a brief presentation of suggestions for handling farm manures in a way to best preserve the nitrogen which they contain, together with information necessary to make effective use of the various leguminous cover crops.

### MANURE CONSERVATION

Because animals retain only about 20 per cent of the nutrients which they consume, much of the plant food taken from the soil by crops can be returned by careful handling of manure. However, special care is necessary to avoid loss of much of the nitrogen.

Superphosphate used in the stable gutters, in protected feeding barns, and on dropping boards at the rate of 1½ pounds daily for each 1,000 pounds of animal liveweight absorbs much liquid manure and ammonia, and results in a better balanced fertilizing material. Plenty of bedding should be used to conserve urine.

Drying and freezing of manure exposed in the field cause much loss of nitrogen. This loss can be avoided in large measure by plowing or disking the manure under soon after it is hauled to the field.

Manure which must be stored for a period should be kept moderately moist and compact to prevent "fire-fanging" and the loss of nitrogen by volatilization. However, excessive moisture may cause leaching.

Moderate dressings of manure, 5 to 8 tons per acre, applied to such crops as tomatoes and other heavy feeding, high-acre-value crops will result in greatest returns per ton. If ample supplies are available, applications up to 20 tons per acre may be made with profit. A very light top-dressing, 2 to 4 tons to the acre, on soils where difficulty has been experienced in getting a successful stand of clover or other legumes is often very effective in securing both better legume stands and larger growth.

## COVER CROPS

*Types:* Cover crops are of two types, those intended primarily to provide organic matter and those intended primarily to accumulate nitrogen from the air. The former type, represented by such crops as rye, sorghum, and the grasses, help to prevent loss of nitrogen by taking up soil supplies as they become available and building them into plant tissues so that they may be held for use by commercial crops when the cover crops decompose or rot. However, the accumulation of mature, woody tissue of such plants results in temporary withholding of nitrogen from a succeeding commercial crop because additional supplies are used during decomposition. Therefore, the crop immediately following such a woody green manure crop is likely to suffer unless a heavy application of commercial nitrogen is made. To aid in a period of nitrogen shortage such crops should be used only where legumes are not adapted and when used they should be turned under while young and succulent.

The legumes, intended primarily to accumulate nitrogen, produce organic matter also. Naturally, most of this organic matter decomposes quickly. Domesticated legumes as a group tend to be more restricted than non-legumes in their soil requirements. However, the introduction and commercial development of acid tolerant ones in recent years has tended to overcome this difficulty.

*Seed Supplies:* Fortunately, seed supplies of many legumes are relatively abundant. Steps were taken by the Government last year to encourage increased seed production of many species. Among the crops for this area special emphasis was placed on crimson clover and hairy vetch.

*Prices:* In spite of relatively abundant seed supplies, prices are likely to continue fairly high. It was felt necessary to insure good returns to the growers if increased supplies of seed were to be produced for the emergency that was anticipated. However, commercial cover crop seed prices are in keeping with prices for food crops. Therefore, use of this seed constitutes an economical investment, particularly in the light of the fact that commercial nitrogen supplies are likely to be definitely limited.

As an indication of what lies ahead, the War Production Board has already officially requested that no nitrogen be used in fertilizers

for fall seeded small grains. Further restrictions in manufacture and use of nitrogen carrying fertilizers are under consideration by Federal agencies.

*Varieties:* For many of the leguminous green manure crops the variety does not need to be designated because in some cases only one variety is standard on the market, while in others variety is of little importance when the crop is to be plowed under. At present seed prices common alfalfa grown no further south than Kansas should be satisfactory over practically all of the State. Oklahoma seed should be sufficiently hardy for the southern counties. Foreign seed is not recommended because of uncertainty concerning its hardiness.

Most of the cheaper cowpeas on the market are mixed and are sold as such. Soybean prices are most favorable for the local hay varieties, such as Wilson or Virginia. No others are better adapted to the area. For Southern Maryland and the Eastern Shore, Kobe lespedeza is equally as desirable as Korean. In fact, this variety may be used elsewhere if the crop is to stand for only one year. Among the vetches, only hairy vetch should be used this far north even though other seed costs less.

Where rye is used in mixture with legumes, the varieties Abruzzi or Balbo are recommended because of their tendency to make heavy winter growth.

*Inoculation:* Commercial inoculum is now so cheap that its use is recommended for all leguminous cover crops.

*Fertilization:* The particular need for use of these legume crops this year is an inadequate supply of commercial nitrogen for agricultural use. The more liberally phosphorus and potassium are applied in their fertilization the greater are the quantities of nitrogen which legumes can be expected to gather from the air. Therefore, since they will be used chiefly in preparation for crops with a high money value, 400 to 800 pounds of 0-14-7 or 0-12-12 fertilizer per acre is recommended. Fertilizer used at this rate should be applied separately, either by drilling or plowing under, to prevent seed injury.

*Seed Bed Preparation:* For best germination and growth all cover crops require well prepared seed beds in order that soil moisture may be held in contact with the germinating seeds. The smaller the seeds the more firmly the seed bed should be compacted. Those that are seeded in the spring in fall planted small grain should be seeded either so early that the last spring settling of the soil will establish close contact or they should be planted with a drill or other implement that covers the seed lightly with soil.

Where the cover crop is to be seeded at the last cultivation of row crops, the intertilling has usually created a good seed bed although moisture may be lacking. Under these conditions small seeds, such as those of clovers, should be scattered just after the last cultivation

LEGUMES FOR GREEN MANURE, COVER, AND FOR INCREASING SOIL NITROGEN

Crop	Approximate* planting dates	Pounds seed per acre		Soil Adaptation	Climatic range
		Alone	In Mixture		
Perennial and Biennial Legumes					
Alfalfa	March 20 to April 20, and Aug. 1 to Sept. 1	15-20	8-12	Fertile Well drained Neutral or mildly acid	Statewide
Ladino clover	March 20 to April 20, and Aug. 1 to Sept. 1	3	1	Fertile Good moisture Medium to heavy texture Mildly acid	Statewide
Red clover	March 20 to April 20, and Aug. 1 to Sept. 1	12-15	5-10	Medium fertility Moderately acid	Statewide
Sweet clover	March 20 to April 20	15-20	5-10	Low fertility Neutral or mildly acid	Statewide
Lespedeza Sericea	March 20 to May 1	15-20		Low fertility Medium to strong acidity	Statewide except higher elevations
Annual Summer Legumes					
Cowpeas	May 20 to June 15	90	30-60	Low fertility Medium to strong acidity	Statewide except higher elevations
Soybeans	May 20 to June 15	90	30-60	Medium to low fertility Medium acidity	Statewide
Korean lespedeza	March 20 to April 20	25-35	5-10	Medium to low fertility Medium acidity	Coastal Plain and Southern Piedmont
Annual Winter Legumes					
Crimson clover	Aug. 1 to Sept. 1	12-20	6-10	Medium to low fertility Medium acidity Moderate to good moisture	Coastal Plain and Southern Piedmont
Hairy vetch	Aug. 1 to Oct. 1	30-35	20-25	Medium to low fertility Medium to strong acidity Rather drought resistant	Statewide

\* The recommended planting dates are those best suited for the respective plants. The earlier spring planting dates are for the southern and central portion of the State and the later planting dates for the northern and western regions. Practically all of these crops can be planted ten days or two weeks earlier or later than the recommended time for planting, particularly when they are planted in row crops for winter cover or when planted for green manure purposes.

so that they will settle into the loose surface. Preferably they should be covered lightly with a spike tooth cultivator. Large seeds, such as those of cowpeas or soybeans, are not likely to be covered too deeply by the standard cultivator. Therefore, they may be scattered just ahead of the last cultivation.

When a cover crop is to be seeded soon after harvesting a "money" crop, the proper procedure to follow will depend upon the lightness of the soil, the moisture content of the soil, amount of plant refuse present, and the machinery available for the job. As a rule, a thorough disking will serve as the initial step. However, on very compact soils, as well as on light soils covered by an excessive amount of trash, disking may prove inadequate. Provided soil moisture is ample for a good job, plowing under these conditions is to be preferred. When either disking or plowing results in a deep, loose layer of soil, it is advisable to use a roller or a cultipacker in order to create a firm bed before seeding. Small seeds, such as the clovers, may be broadcast on the compacted bed and then pressed into the surface with a roller or cultipacker. Larger seeds, such as rye, vetch, cowpeas, and soybeans, are most conveniently seeded on the compacted bed with a grain drill. If no drill is available, the latter can be broadcast and then harrowed in with a smoothing harrow.

*Planting Recommendations:* In Table I (page 7) are presented the normal planting recommendations for the most important green manure or cover crops for this area.

## MORE LEGUMES IN ROTATION FOR FIELD CROPS

Increased use of legumes provides one of the most important ways of maintaining yields of field crops without commercial nitrogen. This increase can be brought about by planting legumes which are best adapted to the soil and environment; and by supplying the required lime, phosphorus, potash, and minor elements.

Rotations in which red clover is grown do not have legumes present after the second year when the fields remain in hay or pasture for two or more years following each seeding. Timothy uses much of the nitrogen stored in the soil by clover after the latter dies, thus reducing the supply available for crops which follow.

On Coastal Plain soils and areas in the Piedmont region adapted to Korean lespedeza, 5 pounds per acre planted with the regular hay seeding will often provide a leguminous crop until the soil is plowed. Should red clover smother out the lespedeza the first year, the latter may be reseeded by planting 10 to 20 pounds of seed on the timothy sod the following spring. The field may need a light harrowing with a spring-tooth harrow or spike harrow before seeding to provide good contact for the seeds.



Ladino clover at the rate of 1 pound per acre planted with the regular hay seeding will serve likewise to provide a legume in the later years of sod on fertile to moderately fertile soils in the Piedmont region and in mountain valleys where lespedeza is not adapted. It may also be used where lespedeza is recommended, provided the soils are sufficiently fertile and are well supplied with moisture.

Alfalfa may be added to the seeding also on fertile soils nearly neutral in reaction and well drained.

The application of lime as needed and 300 to 500 pounds per acre of superphosphate or 0-14-7 at the time of seeding or as a top-dressing will aid in assuring a better stand of the legumes and greater production of green material.

When two or more row crops are grown in succession, such as corn followed by corn, winter cover crops should be employed in a way similar to that recommended for intensive specialized canning crop rotations.

## USE OF COVER CROPS FOR VEGETABLES

Where commercial acreages of vegetables, particularly canning crops, are grown on general farms, they usually supplant part of the corn acreage, with no further use of cover crops than those included in the regular rotation. However, where vegetables are grown intensively as specialized crops, green-manure and cover crops may be more generally used to supplement the present low supply of nitrogen as well as to add organic matter to the soil. In view of the present nitrogen shortage, legumes are recommended wherever possible in preference to such crops as rye, sorghum, Sudan grass, and field corn. The following suggestions are grouped according to time of harvest of the vegetable crops.

*Cover Crops Following Early Vegetables*, such as peas, spring spinach, early cabbage, and early market snap beans.

If early spring crops can be harvested in time to prepare the land for green-manure crops by the latter part of June or the first of July, either soybeans or cowpeas may be planted for turning under by the first of October. Hairy vetch, or a mixture of hairy vetch and rye, may then be planted as a winter cover crop for turning under in late April or early May. If early spring crops are to be planted the following year, the soybeans or cowpeas might better remain on the land until late winter or early spring plowing.

When late planted crops, such as tomatoes, sweet corn, or lima beans, are to be grown the following year, sweet clover may be seeded in canning peas at the time of planting. Sweet clover is not recommended unless the soil has been well limed, and it should not be plowed under until the middle of April or later the following year.

*Cover Crops Following Mid-Season Vegetables*, such as early cantaloupes, cucumbers, early potatoes, early sweet corn, early tomatoes, snap beans for canning, and lima beans for market.

Where mid-summer vegetable crops are harvested in time to work up the land for August planting, crimson clover makes an excellent cover crop on the Eastern Shore, if late spring or summer cash crops are to follow the next year. Crimson clover should not be turned under until it is in early blossom.

When the last cultivation of early tomatoes or sweet corn comes the last of June or early in July, either cowpeas or soybeans may be broadcast just before this working. These crops can be turned under in the fall in time to sow a winter cover crop or they may remain on the land until spring.

Hairy vetch, or a mixture of vetch and rye, may be seeded from late July until the first of September where early spring crops are to be planted the following year. If seeded this early, sufficient fall growth will be made to warrant the use of such cover, without having to delay early preparation of the land for the succeeding crop. If late spring and summer crops are to follow, the vetch, or vetch and rye, should be seeded the latter part of September or the first of October, the principal growth occurring the following spring.

*Cover Crops Following Late Vegetables*, such as late tomatoes, late sweet corn, and lima beans for canning.

When a late spring crop is to be planted the following year, crimson clover makes a good cover and green-manure crop on the Eastern Shore when broadcast in late sweet corn and tomatoes at the last cultivation, provided this comes in August.

When an early spring crop is to be planted the following year, vetch or a mixture of vetch and rye may be broadcast in row crops, such as tomatoes and sweet corn, at the last cultivation any time between late July and the first of September. Sown at this time the fall growth utilizes the available nitrogen and prevents leaching from the soil. If late spring crops are to be planted the following year, rye, or rye and vetch, can be planted in the fall after preparation of the land following the harvesting of summer crops. Vetch should not be included unless seeded by the first of October.

Where land cannot be prepared for seeding cover crops until the first of October or later, and an early spring crop is to be planted the following year, it is more economical to leave the crop refuse and natural weed growth on the land than to seed a cover crop.

#### USE OF COVER CROPS, MANURES, AND MULCHES FOR FRUITS

*Annual and Biennial Covers:* For cultivated orchards, the more extensive use of such legumes as soybeans, cowpeas, or Korean lespedeza

is recommended, especially for young orchards or for bearing orchards on soils that are not too shallow to support a good cover as well as satisfactory tree and fruit growth. Cowpeas or soybeans, seeded in early June, will make sufficient growth by September 1st that they can be disced under and the orchard immediately reseeded to winter vetch, rye, or a mixture of rye and winter vetch, the customary winter covers, although it is advisable to increase the vetch and decrease the rye in the mixture. In case no winter cover is sown, the soybeans or cowpeas may be allowed to grow to maturity and then be broken down with a disc or cultipacker, leaving the soil with a rough stubble over winter, and during early spring.

Another legume crop for the cultivated orchard is sweet clover, seeded in early spring, and allowed to grow during the first season with occasional mowing as needed. In the following spring the clover in a mature orchard should be disced down as a green manure crop, followed by trashy cultivation until a winter cover is sown. In the young orchard, sweet clover may be kept in the orchard during both seasons. With acid soils particular attention must be paid to lime applications to get satisfactory conditions for a stand of sweet clover. If rye and vetch mixture, or rye alone are used as a winter cover, sweet clover may be broadcast in such covers about March 15th, with a subsequent mowing of the rye and vetch about May 1st. Without the seeding of sweet clover in the rye and vetch, the winter cover should be disced or mowed about May 1st, followed by a trashy cultivation until another cover is sown. If no summer cover is sown, weeds take the place of the summer cover, but such a cover must be mowed or roughly disced at intervals, and under the present emergency, the use of summer legumes will add nitrogen, whereas weeds will tie up the nitrogen for a time at least. Similarly, the planting of Sudan grass or millet as summer covers are not as desirable as the legumes, but may be used to great advantage for production of mulch material from areas not in orchard.

**Perennial Covers:** Many orchard soils of Maryland have been and are being placed under a more or less permanent cover of non-legume, legume, or mixtures that result in sods which are mowed at intervals to reduce competition with the tree for soil moisture, and should be disced lightly each season in the fall or early spring without destroying the sod cover. Where they are adapted to soil and climate, such perennial legumes as sweet clover, alfalfa, Lespedeza Sericea, and ladino clover should be used in establishing new sod covers, or in reseeding old sods. However, these deep-rooted covers must be avoided in mature orchards on shallow soils where tree and cover must compete for a limited moisture supply, except where such covers are used as green manure crops, as previously noted for sweet clover. In fact, mowing of these crops, especially during critical moisture periods, is very important in the mature orchard; otherwise fruit size may be limited. These legumes are of particular benefit in building the fertility of the young orchard and for furnishing mulch for young trees.

Sweet clover and alfalfa are familiar as covers for Maryland orchards, but Lespedeza Sericea and ladino clover are not so well-known. It should be noted that Ladino clover requires a fertile soil for success, whereas Lespedeza Sericea will succeed under low fertility conditions. Where it can be grown, Korean lespedeza offers a shallow rooted crop, for the shallow soils where deep-rooted legumes are not advised, and by its habit of reseeding itself annually can take the place of the perennial legumes on the shallow soils. With any sod cover in the orchard, it is essential to apply mixed fertilizers annually and lime as needed to maintain good growth of the cover.

*Manures and Mulches:* Although manure and mulch materials have been limited in supply for orchards, the great benefits from their use cannot be over-emphasized. With even small amounts of manure, the orchardist is advised to use strawy manure as a mulch for young apple and peach trees from the time of planting and during two or three years following, if possible. Other mulch materials may be substituted for manure and give good results but not equal to manure. In the mature orchard, manure as a light top-dressing of 5-10 tons per acre has shown marked results, especially on sods. In some sections of the state, chicken manure is available and is giving good responses in the orchard, especially when the manure has some litter and can be broadcast and worked into the soil.

Mulch materials in the form of straw or other plant residues are hard to obtain, so that the orchardist should plan to grow some mulch materials on farm areas not in orchard. Sudan grass, rye, sweet clover, and Lespedeza Sericea are crops that can be grown to furnish such mulch in quantity with an advantage for the legume crops in terms of added nitrogen.