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TRAINER MANUAL

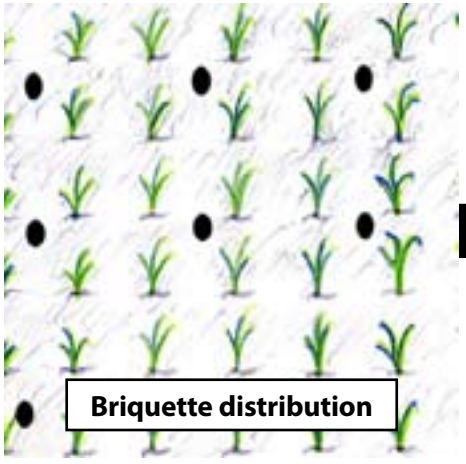
UREA DEEP PLACEMENT (UDP)

A TECHNOLOGY DEVELOPED BY IFDC TO IMPROVE NITROGEN FERTILIZATION IN IRRIGATED RICE SYSTEMS


Prilled urea


Briquetting machine


Urea supergranules


Briquette distribution


Deep placement of briquettes


UDP rice fields

UREA DEEP PLACEMENT (UDP)

WHAT IS UDP TECHNOLOGY?

UDP technology was developed by IFDC to improve nitrogen fertilization in irrigated rice systems. UDP involves placing urea briquettes at a depth of 7-10 centimeters between four rice plants. The urea briquettes, often called urea supergranules (USG), are applied seven days after the rice seedlings are transplanted. This covers the nitrogen (N) requirements of rice (for four hills) throughout its growth cycle.

This one-time application of urea briquettes significantly reduces the recommended rates of urea while increasing paddy yields by an average of 15-30 percent. The reduction in the N application rate depends on the soil fertility status, season and cropping system. For instance, the reduction in N application rate averages 65 percent in the Senegal River Valley and 25 percent in the Kou Valley and Sourou Province (Burkina Faso).

N is a critical nutrient for plant growth and seed formation. UDP reduces the amount of N lost through runoff, leaching and volatilization and improves N availability for the crop.

UREA SUPERGRANULES (USG)

USGs are produced by compacting granular or prilled urea through a briquetting machine. This is simply the physical processing of granular or prilled urea without any physical or chemical ingredients. The briquetting process of a 50-kilogram (kg) bag of prilled urea yields about 49.5 kg of USG.

This briquetting process is also applied to conventional fertilizers (TSP, KCl, DAP, etc.), compounds (NPK) or fertilizer blends. However, the briquetting of such fertilizers is more complicated because they are more dense and their specific weight is significantly heavier than urea.

Urea briquettes are round tablets about 1.5 cm (1.8 grams) to 2 cm (2.7 grams) in diameter.

However, the weight of the briquette varies depending on the specific weight of the type of fertilizer that has been briquetted. For instance, an NPK briquette of about 1.5 cm in diameter may weigh 3 grams compared to 1.8 grams for urea.

Heavy soil cakes under wet tillage or makes hard lumps under dry tillage.

Heavy soil: cracked when dry.

Light soil: crumbly when plowed, even wet.

PERFORMANCE CONDITIONS

TYPE OF SOIL

The UDP technology gives its best results on clay soils with a high water and nutrient retention capacity.

Heavy, dark-colored lowland soils (Vertisols) are the most appropriate to ensure good performance of the UDP technology and reduce losses in the subsoil (leaching), which are very frequent on light, textured soils.

SELECTION OF VARIETIES AND SEEDS

Varieties that respond well to intensification fit better to the UDP technology. These are improved varieties (registered) with high yields (6-7 tons/hectare [ha]). The following characteristics are recommended:

- Intermediate cycles (seedling maturity of approximately 110-125 days) and varieties such as FKR19, FKR 28, FKR 60N and 62N, and TS 2, commonly used in Bama (Burkina Faso).
- Good response to nitrogen and good lodging resistance (dwarf with short tillers - less than 100 cm).
- Abundant tillering and good disease and pest resistance.
- High fertility status (grain type varieties).

The use of long-cycle varieties (> 135 days) is not recommended as this can cause nitrogen deficiency at later growth stages (flowering and grain filling stages).

Seeds are viable rice grains with varietal purity and germination rates greater than or equal to 80 percent, and free of diseases, weed seeds and impurities.

The utilization of "ordinary" seed is strongly discouraged. "Ordinary" seeds generally have low germination capacity and contain weed seeds and other varieties, thus causing heterogeneity in the plot, and as a result, low yields and poor grain quality. The use of certified seeds is therefore recommended.

Productive varieties (tillering yield).

Rice panicles well-endowed with grains.

FARM OPERATIONS ASSOCIATED WITH UDP

NURSERY

- Select less clayey soils to facilitate the uprooting of seedlings. Also avoid very sandy soils to reduce the loss of seedlings by desiccation.
- After proper mudding and leveling, divide the plot into rectangular nursery beds 1 to 1.2 meters (m) wide and with a length that depends on the targeted nursery surface area.

- The orientation of the nursery beds should be perpendicular to the direction of, or against, the slope.
- The nursery must be installed in a location that is accessible, sunny and unfloodable, close to the fields, close to the water source and inaccessible to pests (animals and seed-eating birds).
- The irrigation canals (ditches) that surround the nursery beds also help drain the nursery while maintaining a certain moisture level.
- The seedlings to be transplanted should be vigorous. For this purpose, the recommended plant density is 200 grams (g) per m^2. In the case of a wet nursery, 30-40 kg of seed is more than enough for transplanting 1 ha.

Table 1: *Example for transplanting a given area*

Transplanting Area	Nursery Area	Seed Quantity
0.10 ha	20 m^2	3-4 kg
0.25 ha	50 m^2	8-10 kg
0.5 ha	100 m^2	15-20 kg
1 ha	200 m^2	30-40 kg

TILLAGE

Tillage allows deep loosening of the soil, which facilitates root development. Lumps must be broken to improve transplanting conditions, retention of water (irrigation) and deep placement of briquettes.

Proper leveling of the field allows for consistent management of the water level in the field (without water excess in places), to better control weeds, reduce water and fertilizer losses through percolation and limit the rise of salts from groundwater by the capillarity in salty areas. Combined, these measures create suitable conditions for good seed emergence.

USG should be applied on loose soil to facilitate deep placement.

Tillage (using animal traction).

Mudding and leveling.

TRANSPLANTATION

Transplanting consists of growing rice in a nursery at high density and then planting the seedlings.

It is recommended to transplant the seedlings at 15 to 21 days old in the wintering period. In off-season cropping conditions, they should be transplanted at 21 to 30 days because of delayed growth due to cold temperatures.

Transplanting seedlings older than 30 days should be avoided because the recovery will be difficult and tillering low, causing significant reduction in yields.

Transplanting in rows is highly recommended for UDP use as it allows better management of the placement and spatial distribution of the briquettes.

Transplanting in rows also offers the possibility of using a rotary hoe (cono weeder) for weeding and helps control stocking density (number of plants per m^2). Movements within the field for maintenance activities (hand weeding, fertilizer application, crop protection treatments) are then facilitated.

Keep a spacing of 20 cm x 20 cm.

Random transplanting is not an appropriate option for UDP technology. Its major disadvantages are the inability to use rotary hoe, a high population density and the need for random placement of briquettes.

Recommendations related to UDP technology:

- A planting density of 20 cm between rows and 20 cm between plants (250,000 plant stands/ha).
- A maximum of two to three seedlings should be planted per plant stand.
- If the spacing between plant stands exceeds 20 cm, a briquette should be placed in each plant hole to avoid nitrogen deficiency (see the "Fertilizer" chapter).
- Give preference to improved varieties that have a strong tillering capacity.

Muddy state or light water layer.

IRRIGATION

- Keep the soil in a muddy state with a thin water layer (2 cm) during the first week after transplanting.
- Maintain adequate moisture or a thin water sheet to ensure proper humidification and dissolution of briquettes from the time of their deep placement.
- Permanent moisture allows the release of N in the form of ammonium (NH_4^+). Compared to nitrate (NO_3^-), NH_4^+ is less subject to losses by volatilization and/or leaching.
- Avoid an excessive water layer at tillering.
- Maturation/harvest: maintain the water up to 14 days before harvest.

Constantly wet plot (saturation).

Drain before harvest.

FERTILIZATION

Organic manure and basal dressing

Care must be taken to improve the physical and chemical properties of the soil through an organo-mineral combination:

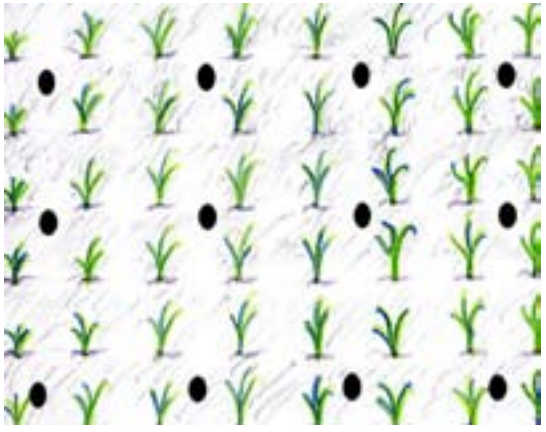
- Apply 5 mt/ha of manure when preparing the soil.
- Combine 200 kg/ha of NPK 14:23:14 or 15:25:15 when transplanting.

Deep placement of USG

- 7 to 10 days after transplanting.
- 7 to 10 cm deep.
- One briquette between 4 plant stands.
- One briquette feeds 4 plant stands, i.e. 40 cm between rows, corresponding to a USG application rate of 113 kg/ha using 1.8 g briquettes and 169 kg/ha with 2.7 g briquettes.

Deep placement between 4 plant stands.

Maintain 40 cm or less between briquettes.



Rice transplanted in rows of 20 cm x 20 cm.

If the plant spacing of 20 cm x 20 cm cannot be kept, it must be ensured that transplanting is done completely in rows. In this case the deep placement of briquettes will take place between the inter-rows every 40 cm, skipping every other inter-row.

However, the action radius of urea briquettes (nitrogen diffusion) varies depending on the type of soil. It is greater in clay soils than in sandy soils. If the distance between plant stands is greater than 40 cm, one urea briquette must be placed for each plant stand (rice) or plant (other crops) to ensure adequate plant nutrition.

Table 2: *Application of urea nitrogen according to the spacing and specific weight of briquettes*

Weight of briquette (g)	**Spacing (cm)**			
	15 x 20		20 x 20	
	N	*USG*	*N*	*USG*
	(kg/ha)			
1.0	38	83	29	63
1.2	46	100	35	75
1.4	54	117	40	88
1.6	61	133	46	100
1.8	69	150	52	113
2.0	77	167	58	125
2.7	103	225	78	169
3.0	115	250	86	188

CROP MAINTENANCE

- Manual weeding, preferably, as needed.
- Avoid using the rotary hoe between the rows where the briquettes have been placed.
- Crop protection treatment as needed.

A well-maintained rice field.

HARVEST AND POST-HARVEST

- Drain the field one to two weeks before harvest.
- Harvest when 80 percent of the panicles are straw-colored.
- Proceed with threshing the earliest to avoid losses.
- Properly dry the paddy (moisture 12-13 percent).
- Store and keep in a dry and ventilated place.

Mechanized rice threshing.

BENEFITS OF UDP

The following benefits are observed from farmers using UDP:

- Efficiency of nitrogen fertilization.
- Reduction of the rate of fertilizer urea applied (30 percent).
- Increases in rice production by 15 to 30 percent, or an increase of at least one mt/ha of paddy rice.
- Improved grain quality (good filling).
- Reduction of weed infestation.
- Reduction of production cost.
- Increases in gross margins.
- Increases in income.

*Paddy produced with **urea***

***Urea**: 2 bags lost out of 3*

*Paddy produced with **UDP***

***USG**: only 1 bag lost out of 3*

CONSTRAINTS RELATED TO UDP

- Availability of labor for manual application.
- Labor cost.
- Timely availability of briquettes.
- Soil characteristics: The placement of briquettes in permeable coarse-textured soils leads to high nitrogen losses.
- Financing the briquetting machine.
- Fertilizer briquettes are a little more expensive than conventional fertilizers (10 percent).

Broadcasting urea is less cumbersome.

Deep placement by hand is labor intensive.

A solution to the labor constraint related to deep placement: **mechanization.**

RECOMMENDATIONS

- Application under irrigated conditions or in irrigated lowlands with proper water control.
- Heavy soil with a percolation rate between 5 and 10 mm/day and a cation exchange capacity (CEC) greater than 10 meq/100 gsol.
- Use of improved varieties, short or medium cycle (90-120 days), that respond well to nitrogen fertilization.
- Application to other irrigated vegetable crops such as tomato, onion, shallot, etc.

CONCLUSION

With UDP a greater amount (more than one mt/ha) of paddy can be produced using less urea.

The positive effects are as follows:

- Availability of nitrogen across all growth stages.
- Improved nitrogen efficiency (30 to 60 percent greater) with extended greening and good grain filling.
- Lowered environmental impact from less N losses through leaching, volatilization, nitrification and denitrification.

UDP technology contributes to improving farmers' income, food security and environmental conservation.

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